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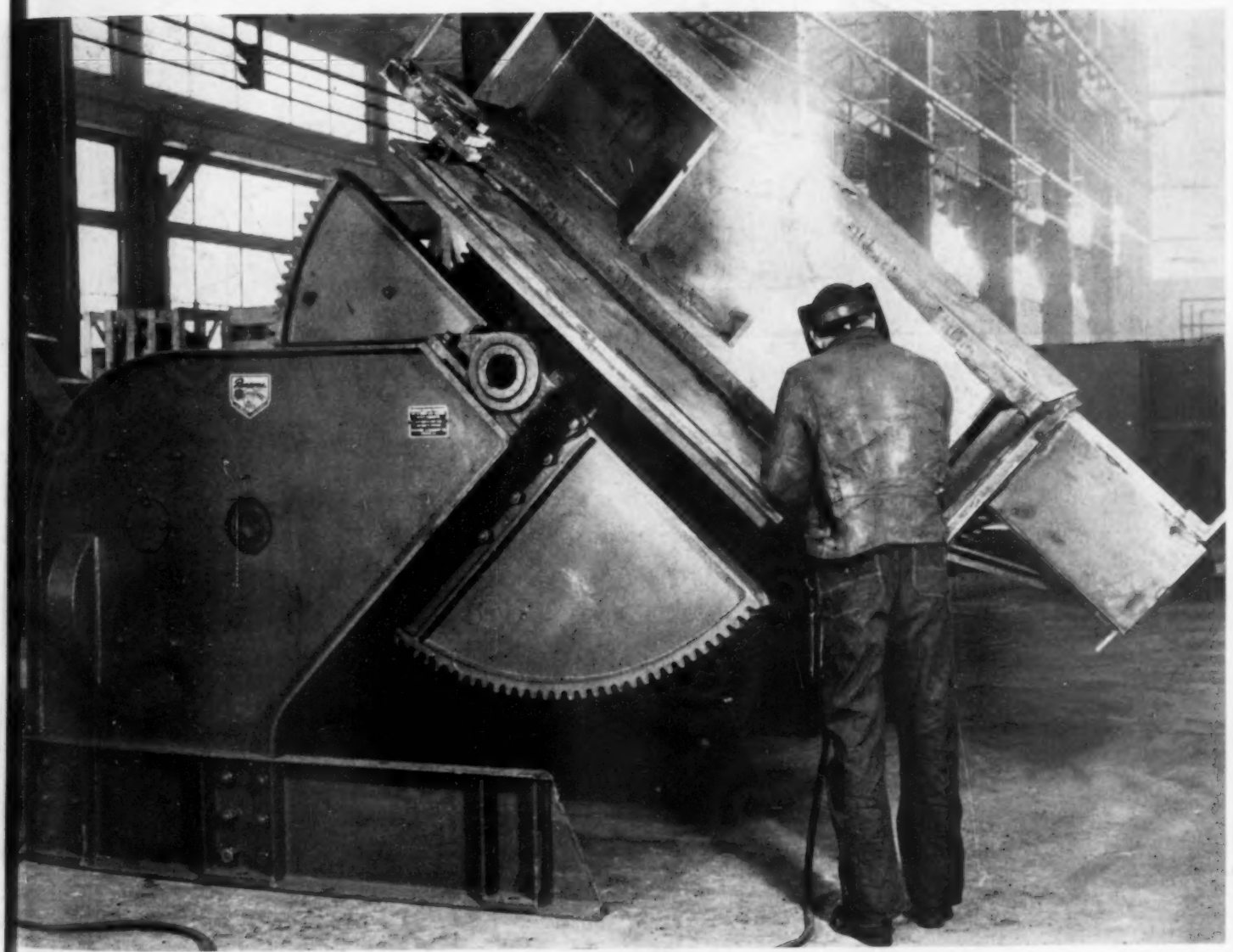
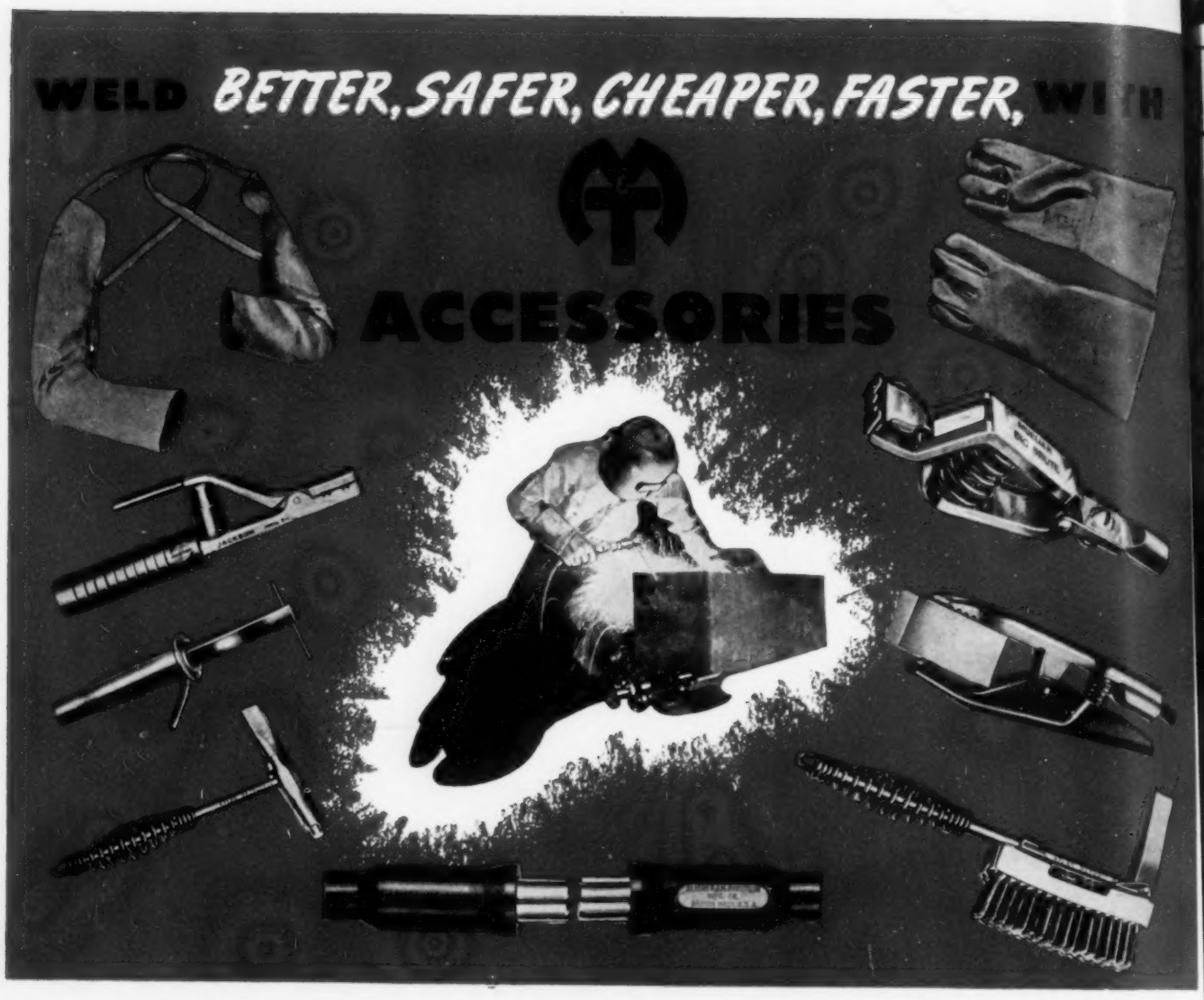


The Journal of the American Welding Society



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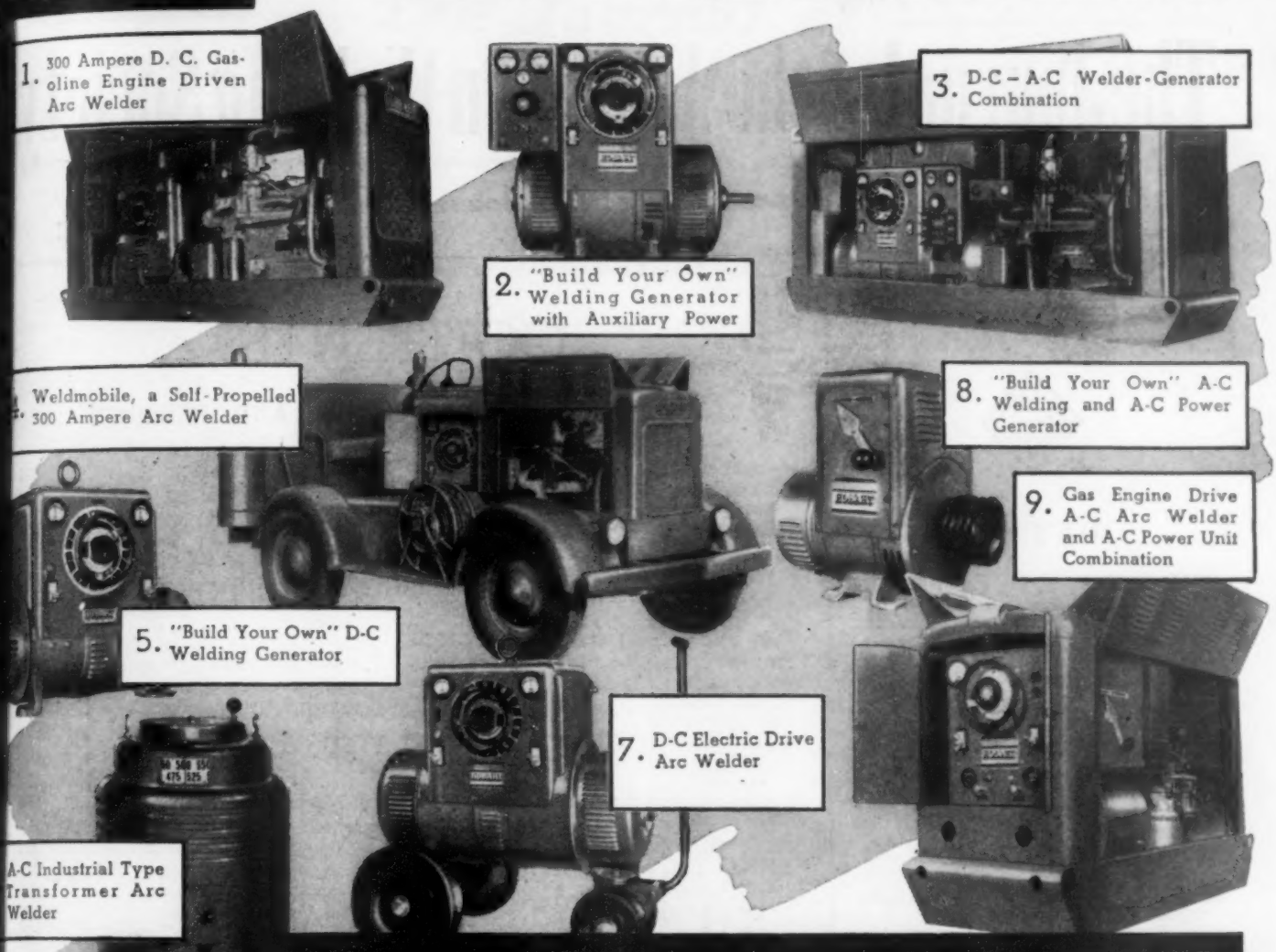
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Welding and Low-Temperature Brazing of Air Conditioning and Refrigeration Parts*

By Ward Swarthout†

Introduction

FOR two very outstanding reasons the employment of acetylene gas is essential to fabrication technique throughout many phases of production in the air-conditioning and refrigeration industry. The character of the materials used—piping, tubing, coils and others—is such that fitting, closure, jointing, mounting and other major operations can be more efficiently accomplished by oxyacetylene applications than by other methods available. Further, the usually intricate design and arrangement of many of the parts and equipment produced lend themselves much more satisfactorily to oxyacetylene than to other fabrication techniques.

It is but natural, therefore, that an organization already engaged in working with such materials, and specializing in welding, brazing, soldering, cutting and other oxyacetylene fabrication methods would be drawn into air-conditioning and refrigeration equipment manufacture early in the development of this new and rapidly growing industry.

* Paper presented before the 50th Anniversary Convention of the International Acetylene Association, Detroit, Mich., May 3–4, 1948.
† Process Engineer, Acme Industries, Inc., Jackson, Mich.

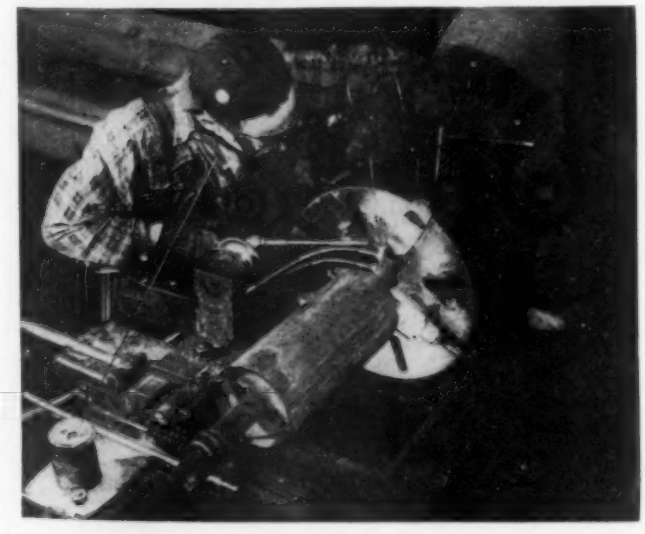


Fig. 1—The Start of Coil Winding for a Freon Shell and Coil Condenser

The end of the tubing is being silver-soldered into the header connection, using Easy-Flo, which melts at about 1175° F

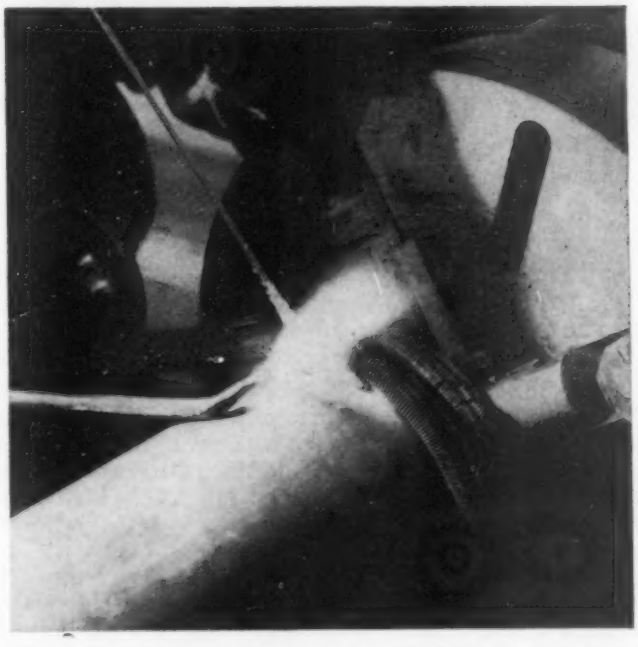


Fig. 2—At Beginning of the Coil, the Tubing Being Tacked to the Drum Support by Brazing, Using a Brazing Rod and Marvel Flux at a Temperature of 1600 to 1800° F.

Typical of the industry's products to which oxyacetylene applications are essential on a wide scale are welded pipe coils, air-conditioning coils, finned coils, Freon shell and coil condensers, ammonia and Freon shell and tube condensers, heat exchangers, oil separators, forced convection unit coolers, liquid receivers, water coolers and other allied products.

Design Factors

It is only in the last fifty years that man has learned how to devise methods of refrigeration and air conditioning adequate to develop extremely low temperatures and maintain them under controlled conditions over a constant period. The rapidly growing demand for equipment of this type to implement modern industrial processes has led to the development of a wide range of refrigeration and air-conditioning methods, and many types of devices.

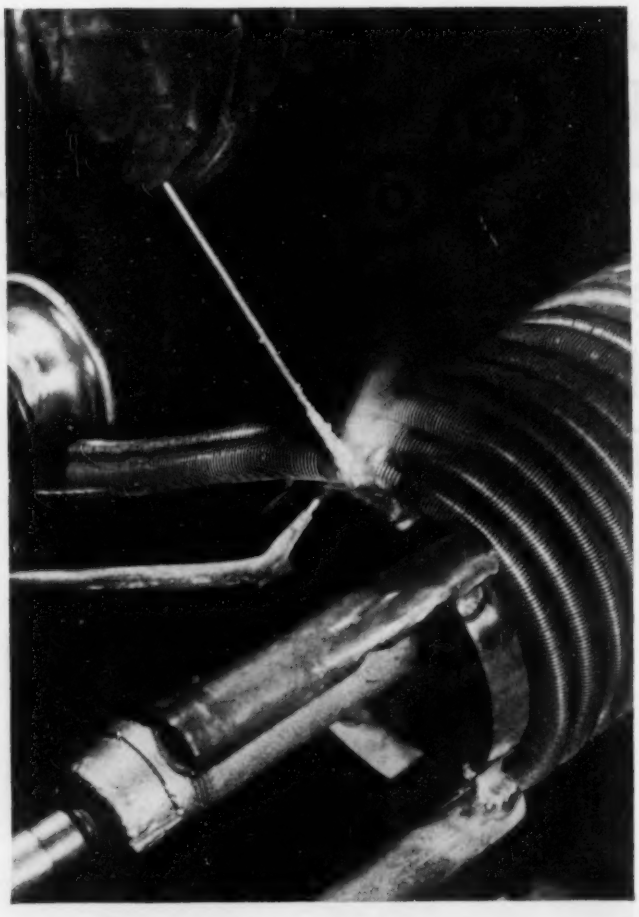


Fig. 3—Tubing Being Tacked in the Same Manner at End of the Wind

But, however diverse their design, all rely upon the fundamentals of heat exchange principles. The transfer of heat from a warm stream, either gaseous or liquid, to a countercurrent cold stream, and the repetition of this exchange to reach the desired temperature levels, is a necessary fundamental in every refrigeration and air-conditioning system.

The devices for performing this exchange vary greatly in design, according to the intended use and the temperature levels required. But all such devices entail more or less intricate structures of tubing, piping or coils, many of them encased in shells to permit countercurrent flows under controlled conditions.

Such structures involve innumerable fittings, closures and joints to which welding, brazing, soldering and cutting are indispensable fabrication processes. Welding and cutting are the primary operations in producing the shells for housing such units and in adding the external connections.

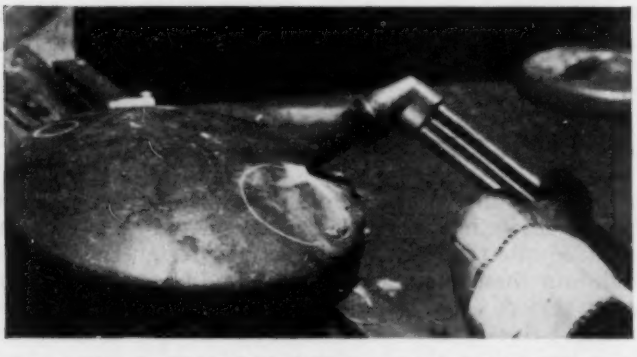


Fig. 4—A Drawn Metal End Stamping for a Heat-Exchanger Being Cut with an Oxyacetylene Torch to Provide Opening for Sweat Fitting

Fig. 5—Sweat Fitting Being Silver-Soldered in Place in the End Stamping

Easy Flo No. 36 is being used with Handy Flux, at about 1175° F.

A further complication inherent to the internal design of heat transfer units is the requirement for a maximum area of contact between the stream in the tubes, pipes or coils, and the stream flowing countercurrent between them and the outer shell.

Of many methods for achieving the maximum area of contact in as small and compact a unit as possible, a common one involves the use of fins or other types of heat-conducting devices, the arrangement of which is also best adapted to oxyacetylene processes.

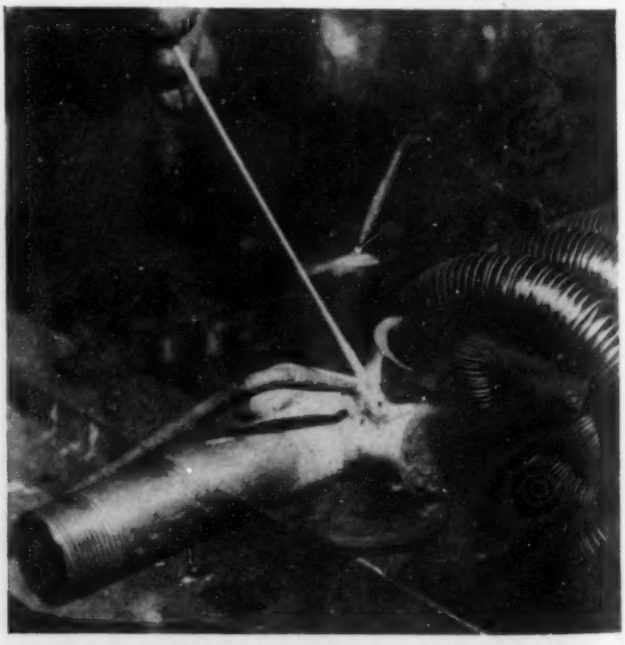


Fig. 6—A Double-Exposure Photograph Showing Two Contrasting Operations

The upper torch is welding an end plug of a condenser header, using $^{3}/_{32}$-in. steel welding rod at 1800 to 2500° F. The lower torch is being used to braze the end of a tubing coil into a header assembly, a $^{1}/_{16}$-in. brazing rod being used at 1600 to 1800° F.

Gas Supply

The oxygen supply used is of standard 99.5 per cent purity, and is provided by a battery of trailers installed outside the plant. An uninterrupted flow of oxygen is fed through the control station to a continuous pipe line installed throughout the plant.

The acetylene supply is furnished by two conventional type acetylene generators, separately housed near the outdoor oxygen station. As the supply in one generator is exhausted, the other is switched into the plant pipe line; providing a constant supply at all times.

To obviate the disadvantages of a pit for acetylene sludge disposal, we have devised a special trailer which is hooked up to the sludge outlet from the generators. When filled, the trailer is hooked to a truck for removal to a disposal area, where it is dumped. A screw-type pusher, similar in principal to a coke-pusher, is installed in the trailer for operation from the front end to speed up drainage of the sludge from the trailer.

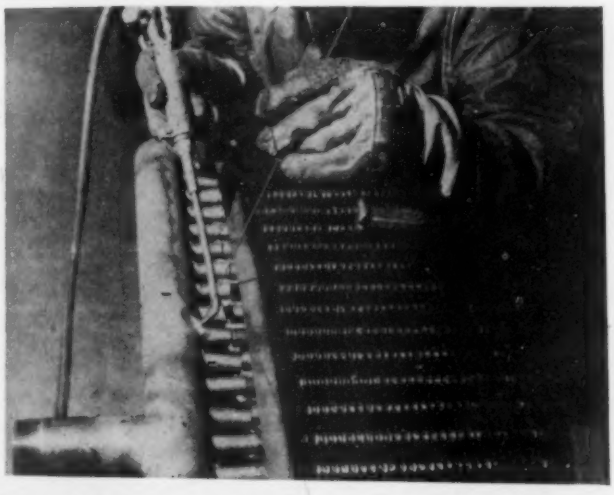


Fig. 7—Connecting Tubes Being Fitted and Tack-Welded Between a Finned Coil Assembly and Its Header Connection

A 1/16-in. steel rod is used at a temperature close to 2500° F.

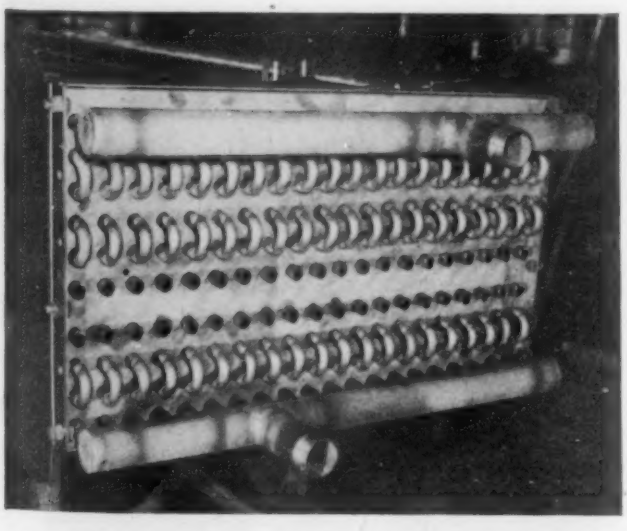


Fig. 8—One End of a Partially Completed Industrial Cooling Unit

Return bends of the finned coils and two headers have already been welded in place. Open-end tubes extend through the end stanchion to provide for two additional headers yet to be assembled.

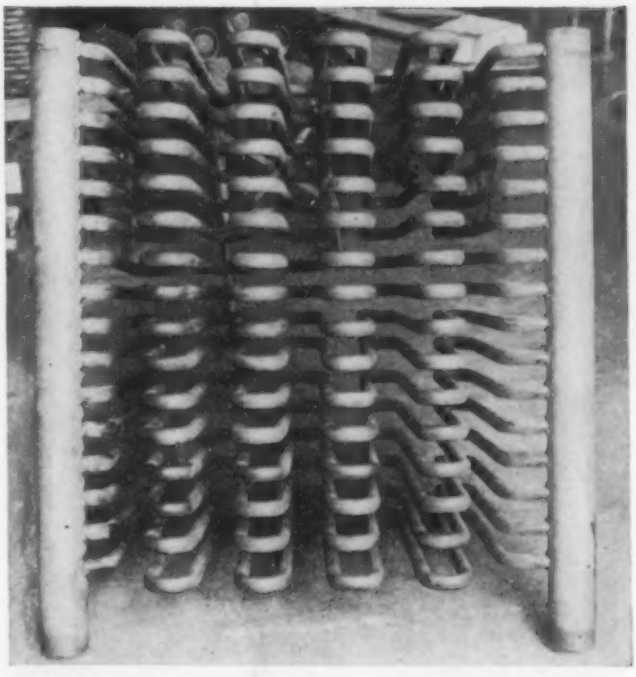


Fig. 9—A Gas-Welded Evaporative Condenser Pipe Coil Shows the Intricate Pipe-Bending Operation Involved in Such Equipment

The ends of each tube have been welded to the header.

Fig. 10—Header Connections Being Welded to One Type of Evaporative Condenser Coil, Using 3/32-In. Steel Rod at Close to 2500° F.

Applications

An account of all oxyacetylene applications to production methods in the air-conditioning and refrigeration industry would cover the gamut of oxyacetylene usages. Those here described are typical of the more interesting applications uniquely suited to production requirements of this industry.

"Heat Pumps" are one of the newer developments in the air-conditioning field to the fabrication of which oxyacetylene methods are especially suited. They are

Fig. 11—Trimming the Nuts and the Bolt Ends from Tension Rods on an Evaporative Condenser Assembly, Using an Oxyacetylene Cutting Torch

designed to provide a transfer of heat from the earth to the surface during winter, and cold from the earth to the surface during summer, as a means of heating and cooling houses.

A Freon shell and coil condenser forms the basic design of the heat pump. For its fabrication, a hollow drum

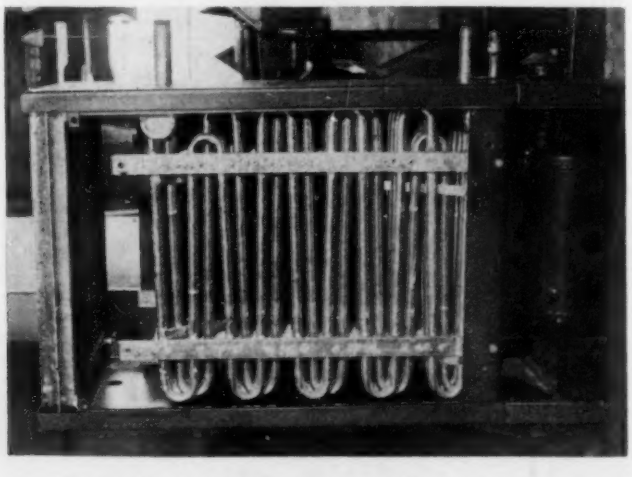


Fig. 12—A Galvanized and Finished Evaporative Condenser Fitted Into Place on the Final Assembly

The subassembly shown assembled in the base is a welded Freon receiver tank.

Fig. 15 (Right)—An Automatic Oxyacetylene Cutting Torch in Process of Simultaneously Cutting and Beveling a 20-In. Pipe to Provide Shells for Condensers

The torch remains fixed, while the pipe revolves at a controlled rate. The torch is attached to the jig by a movable standard.

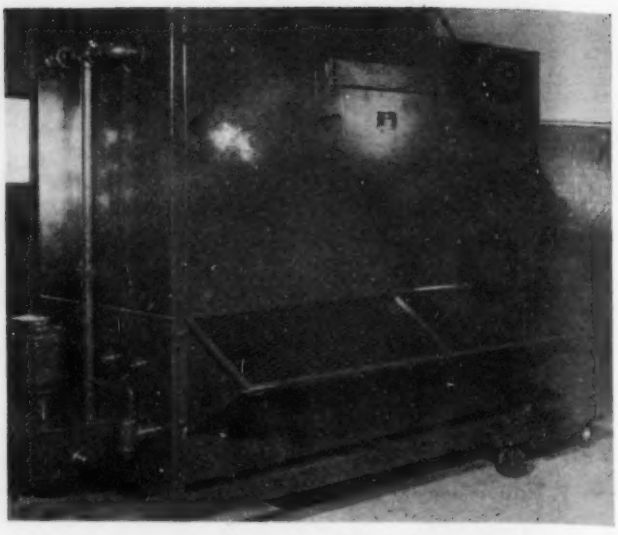


Fig. 13—The Lower Section of a Large Evaporative Condenser Ready for Installation

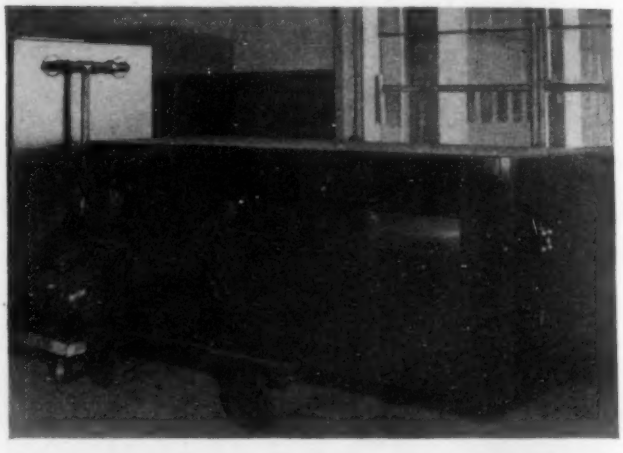
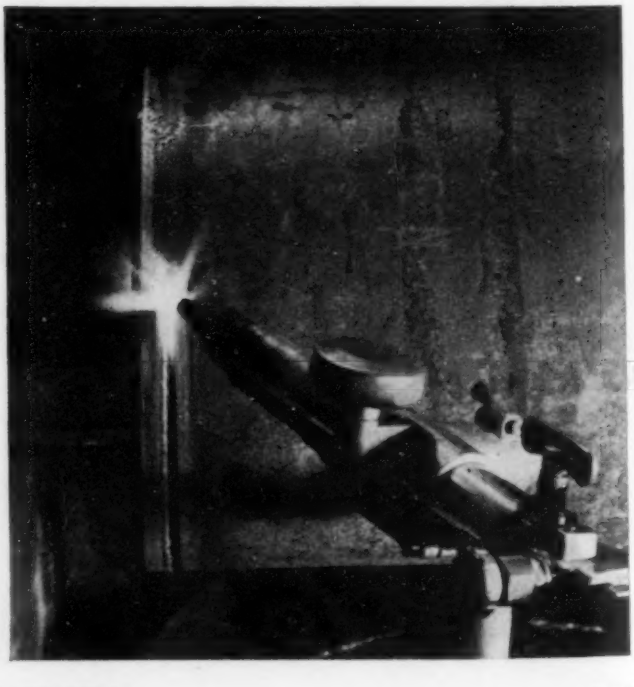


Fig. 14—The Upper, or Fan, Section of a Large Evaporative Condenser

When installed, it will be assembled on top of the section shown in Fig. 13.



support is fitted into a jig (Fig. 1). Two strands of copper tubing, which is finned to provide larger contact surface, are silver-soldered to the header connection at the end of the drum, as shown in Fig. 1. For this operation, Easy-Flo No. 35 brazing alloy which melts at about 1175° F. is used.

When this joining is completed, the drum is slowly revolved on the jig to wind the tubing about the drum. At the beginning (Fig. 2) and at the end (Fig. 3) of this coiling operation, the tube is tacked to the surface of the drum. A brazing rod and Marvel Flux are used at a temperature of 1600 to 1800° F.

The coiling operation completed, the remaining ends of the two strands of tubing are silver-soldered to the header at the other end of the drum. Easy-Flo alloy at about 1175° F. is also used for this joining.

Metal straps must then be applied lengthwise of the coil to provide a support for the outside coil of the condenser. This mounting is done by brazing each strap to the coil at four points. Brazing rod and Marvel Flux are used at temperatures of 1600 to 1800° F. The unit is then ready for winding and fitting of the outer coil, which is of the same material and applied in a similar manner. The entire assembly is then ready for mounting within the shell.

Typical of oxyacetylene applications to the production of shells for some types of refrigeration is the cutting operation illustrated in Fig. 4. In this case, the drawn metal end stamping for a heat exchanger is being cut with an oxyacetylene torch.

Figure 5 shows sweat fittings being silver-soldered in place in the end stamping. For this operation, Easy-Flo No. 36 brazing alloy is used with Handy Flux, at about 1175° F.

Fig. 16—The Tube Ends of a Freon Type Condenser Being Silver-Soldered Into a $^{3}/_{8}$-In. Thick Tube Sheet

Silver solder No. 45 and Handy Flux are used at around 1175° F.

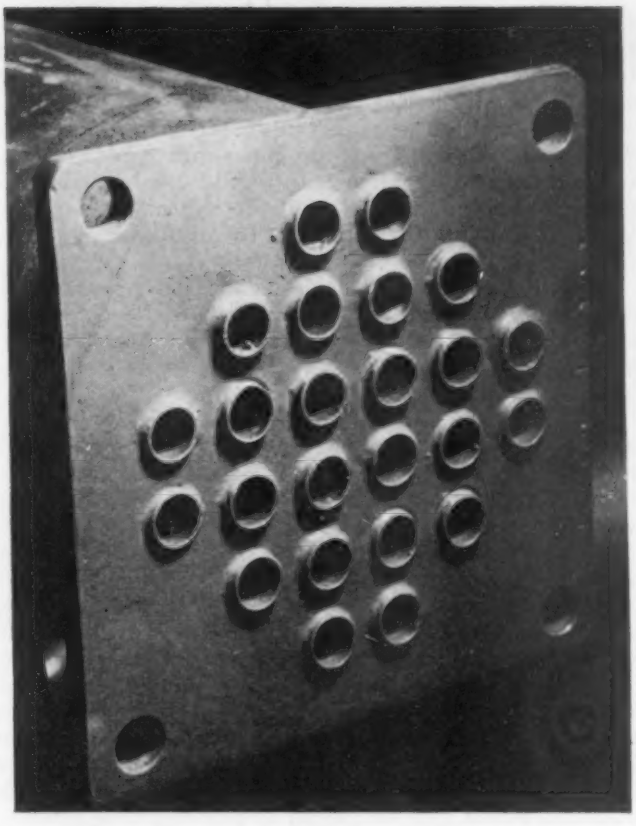


Fig. 17—The Finished Tube Sheet End of a Condenser

The tubes have been silver-soldered in place, and the face of the sheet has been treated with Heresite, a rust- and corrosion-proof material.

An interesting contrast between two different oxyacetylene applications is illustrated in Fig. 6, which is the happy result of an accidental double exposure. The torch operation in the upper portion is the welding of an end plug in a condenser header. For this work $^{3}/_{32}$-in. steel welding rod is used at a temperature range of 1800 to 2500° F. usually close to the higher figure. The work shown below it is the brazing of tubing into a header assembly, using $^{1}/_{16}$-in. brazing rod at 1600 to 1800° F. In this case, the fins of the tubing are stamped from steel sheet and assembled on the tubing, rather than being processed as an integral part of the tube itself.

Oxyacetylene plays a major role in the fabrication of industrial cooling equipment of all types. One such unit is shown in Fig. 7, with short tube lengths being fitted and tack-welded into the header with $^{1}/_{16}$-in. steel rod at a temperature close to 2500° F. These joining tubes provide a connection between the header and the finned coils. They are inserted into holes in the header, tack-welded, fitted while hot to form a butt joint with the open ends of the coil tubes, then welded at both ends.

One end of this unit is shown in Fig. 8 to illustrate the important part gas welding plays in its manufacture. On this piece of equipment, return bends of the finned coils and two headers have already been welded in place. Open-end tubes extend through the end stanchion to provide for two additional headers yet to be assembled.

Figure 9 is a photograph of a gas-welded evaporative condenser pipe coil. The conformation of tubing suggests the intricate pipe-bending operation involved in such work The tube ends have been welded to the headers, as visible along the sides of the headers. Figure 10 shows headers being gas-welded to another type of

evaporate condenser coil, using $^3/_{32}$-in. steel rod at close to 2500° F. A partition has been welded through the center of the header at a 45° angle.

In the final stage of assembly on evaporative condenser coils, tension rods are run through between the tubes, and bolted together. In Fig. 11, the bolt ends and nuts are being trimmed with an oxyacetylene cutting torch, after which the surface of the outer rod is ground smooth.

The finished pipe coil of the evaporative condenser is galvanized, and then fitted into place with header outlets extending through the casing, as shown by the small unit in Fig. 12. The subassembly shown assembled in the base is a welded Freon receiver tank.

Figures 13 and 14 respectively present the lower section of a larger evaporative condenser, and the upper, or fan, section. These are completed units, ready for shipment. When installed, the fan section will be assembled on top of the lower section.

Large pipe is used to fabricate shells, or cases for various kinds of condensers.

The pipe is cut into desired lengths according to the size of condenser shell required. For this operation an automatic oxyacetylene cutting torch is used to simultaneously cut and bevel the rim of the shell, as in Fig. 15, in which a 20-in. pipe is being cut. The jig fixture for this work is of unusual interest, in that the torch remains fixed, while the pipe is revolved at a controlled rate of speed. The torch is attached to the jig by a movable standard which can be placed at any desirable interval along the length of the pipe.

End-plates for condenser shells are cut from steel plate. A four-torch No. 6 shape-cutting machine is soon to be installed to speed up this operation by cutting four disks simultaneously.

Holes are drilled in the cut tube sheet to provide outlets for the copper tubes extending the length of the shell in the Freon condenser construction. In Fig. 16, the tube ends are being silver-soldered into a $^3/_8$-in. thick tube sheet. Silver solder No. 45 and Handy Flux are used for this work at a temperature around 1175° F. The finished tube sheet end of a condenser is shown in Fig. 17. The tubes have been silver-soldered in place, and the face of the sheet has been treated with Heresite, a rust- and corrosion-proof material.

Conclusion

In summing up, it is desired to reiterate that the acetylene gas uses which have been presented are only representative of the many applications which have been developed to meet design requirements and fabrication techniques unique to this industry. New uses for acetylene gas and new techniques in its application are being found constantly as advances are made in the design and employment of air-conditioning and refrigeration equipment, and as increases in volume demand make possible the extension of mass-production methods.

The heat pump, fabrication of which has been described here, is only one of many new types of such equipment. In all cases, acetylene gas continues to prove a tool of primary importance in fabrication of the air-conditioning and refrigeration industry.

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(*Continued on page 526*)

Heavy Steel Tricycle Landing Gear Requiring High Strength Welds

A New High-Strength Welding Rod*

By Lester Tarnopol†

The needs of the Aircraft Industry for a high-strength welding rod for aircraft landing gear are emphasized. Research leading toward the development of a satisfactory rod is described.

Introduction

FOR MANY years the need has existed for an arc-welding rod capable of producing welds in heavy sections of steel 1 in. thick or greater, having strengths comparable with medium alloy steels such as NE8630, after heat treatment. Welds made in thin sections, up to $^1/_8$ in. develop the full strength of the parent metal after heat treatment, since the weld deposit in this case is able to obtain sufficient alloying elements from the parent metal. However, as the cross section increases in thickness the joint efficiency falls off rapidly. At $^3/_4$ in. thickness the joint efficiency for the best alloy rod now available for use with NE8630 is about 70%, after heat treatment of the parent metal to 200,000 psi. tensile strength. At 1 in. thickness this efficiency may be as low as 50%.

The problem of acquiring a high-strength filler-rod for the arc welding of heavy steel landing gear assemblies (see frontispiece) has confronted the aircraft industry for several years and is rapidly becoming more acute. At present some of the joints are flashwelded while others are arc welded, flashwelding being preferred wherever possible. However, present available flashwelding equipment is designed to weld a maximum of about twenty square inches which is insufficient capacity for the large landing gear assemblies now on the drawing boards and contemplated by the aircraft industry for future use. A flashwelding machine capable of handling the larger contemplated assemblies would cost about $200,000 and would therefore make the cost of welding a maximum of about five hundred landing gear assemblies per year prohibitive. Moreover, a flashwelding fixture setup for a few experimental parts costs several hundred dollars, thereby greatly increasing the cost of research on this important landing assembly as compared with arc welding at $3.50 per hour.

The landing gear assembly is subjected to considerable shock in landing and therefore must have maximum physical properties which can best be attained by heat-treated steel. Present available arc-welding rods are capable of producing only about 50 to 60% joint efficiency in these heavy sections after heat treatment. If the welded joint efficiency is low, the necessary proportionate increase in joint area results in a weight increase which in turn decreases the payload of the airplane. For these reasons the development of a high-strength welding rod which could be satisfactorily used for these heavy sections would be of considerable importance to the airplane industry and would undoubtedly find extensive use elsewhere.

Filler-rod vendors have been aware of this problem and occasionally have attempted to develop new welding rods designed to overcome this decreased joint efficiency. Recently the laboratories of the Douglas Aircraft Co. in Santa Monica received for test, samples of a high-strength experimental welding rod—Planeweld AWF 144-4130.* Sufficient experimental rod was available to make two weld assemblies about 4 in. long and 1 in. thick. Two such assemblies were made and tested.

* Data and illustrations from a study submitted to The James F. Lincoln Arc Welding Foundation by Lester Tarnopol, Research Engineer at The Douglas Aircraft Co., Santa Monica, Calif., in its recent $200,000 Design-for-Progress Award Program for reports and advances and improvements made by the applications of arc welding in design, fabrication, construction and maintenance.

† San Francisco City College, San Francisco 12, Calif.

* Submitted by the Lincoln Electric Co.

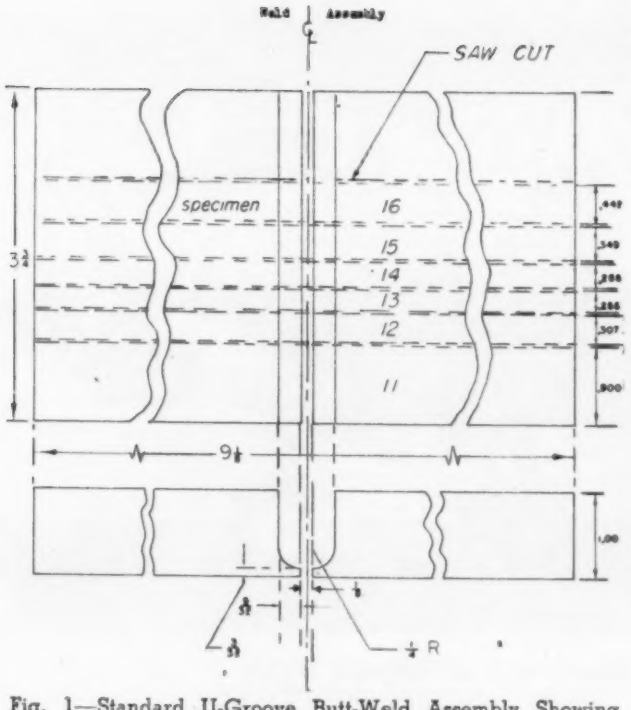

Fig. 1—Standard U-Groove Butt-Weld Assembly Showing Location of Test Specimens

Apparatus and Tests

Two standard U-groove butt-welded assemblies were prepared using the experimental Planeweld AWF 144-4130 rod and 1 in. thick NE8630 plate (Fig. 1). Weld strength evaluations were made on sections cut from the assembly, heat-treated to a parent metal strength of approximately 160,000 psi.

The plates were welded by certified welders under the direction of Douglas Santa Monica Process Engineering. Assembly No. 1 was prepared with the rods as received, whereas the rods used in Assembly No. 2 were thoroughly dried by heating for 1 hr. at 220° F. before welding. The plates were preheated by torch to about 500° F. and were then welded using about ten passes as follows:

Diameter of Rod, In.	Amperes	Volts	Polarity
1/8	80	55–60	Reverse
5/32	120	55–60	Reverse

After welding, the assemblies were torch heated to about 800° F. and straightened in the hydraulic press to remove the slightly V-shaped distortion which occurs in this type of weld assembly.

The welded plates were normalized at 1650° F. and then hardened by water quenching from 1600° F. followed by tempering at 750° F. for 2 hr. and furnace cooling.

The entire welded section of each assembly was subjected to X-ray examination after machining the weld flush with the base plate. Metallurgical analysis, including Rockwell hardness, macro- and microstructure studies, spectrographic analysis and tensile tests were performed on sections cut transversely through the welded plates.

In order to determine the properties of the weld at a higher strength, two tensile specimens which had broken in the parent metal (7 x 0.9 x 0.27 in.) were reheat-treated to a tensile strength of about 225,000 psi. by normalizing at 1620° F. followed by an oil quench from 1600° F. and a 1-hr. temper at 600° F. Rockwell hardness and tensile strength determinations were made on four substandard tensile coupons cut from these reheat-treated pieces, two of which were machined with the weld in the central gage length section while the others were composed entirely of parent metal.

The rod and coating, the parent metal and weld were analyzed spectrographically, the welding-rod-coating analysis being qualitative while all others were quantitative.

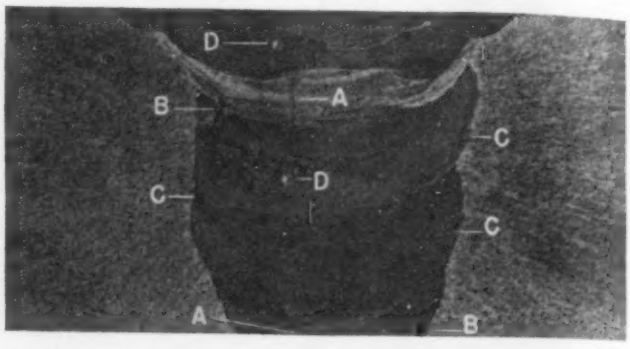

Fig. 2—Macrostructure of Transverse Section Through Weld Assembly No. 2

Specimen No. 2, section 1 in. from end of Assembly No. 2. (*A*) Cracks, (*B*) blowholes, (*C*) pinholes, (*D*) Rockwell hardness penetrations. Etchant: 50% HCl hot, 10 min. × 2.

Fig. 3—Radiograph of Weld Assembly No. 2

Heavy porosity and slag throughout the weld.

Fig. 4—Radiograph of Weld Assembly No. 1

Porosity and slag at end of weld plus a few similar defects in the body of the weld.

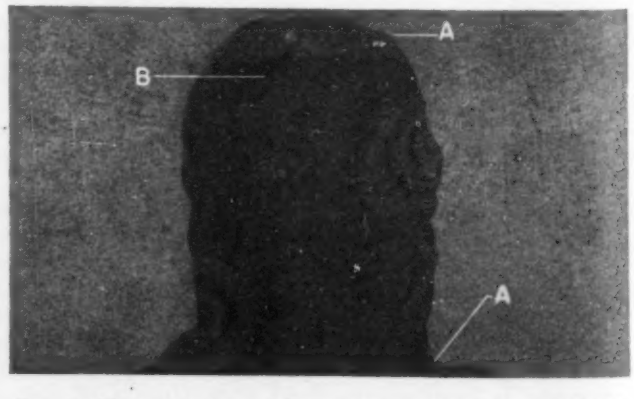

Fig. 5—Macrostructure of Transverse Section Through Weld Assembly No. 1

Specimen No. 11, section 0.9 in. from end of Assembly No. 1 (Fig. 1). (*A*) pinholes, (*B*) parallel hair cracks. The spherical indentation near top-center is a Rockwell hardness penetration. Etchant: 50% HCl hot, 10 min. × 2.

Results

Radiography

After machining the welds flush with the base metal, it was observed that Assembly No. 2 had a longitudinal crack which extended the entire length of the weld at bottom center of the U (Fig. 2, lower crack A) and that it exhibited much more surface porosity than did Assembly No. 1. Radiographic inspection revealed that Weld No. 2 contained considerable porosity and slag (Fig. 3).

In view of the crack plus extensive porosity, Assembly No. 2 had to be rejected for purposes of physical testing. Weld No. 1 was fairly sound except for porosity and slag at the end sections which therefore were not tensile tested. (See radiograph Fig. 4.)

Macrostructure

The macrostructure of a transverse section through the weld in the region of porosity in Assembly No. 1 revealed pinholes plus a small group of parallel hairlike cracks (Fig. 5). A similar specimen from Assembly No. 2 had blowholes, pinholes and cracks (Fig. 2).

Microstructure

The microstructures of the weld deposit and the parent metal after heat treatment were tempered martensite, with the parent metal slightly finer grained (Fig. 6). The microstructure is satisfactory and characteristic for the given heat treatment.

Rockwell Hardness

Rockwell hardness determinations performed on specimens from the weld assemblies after quenching from 1600° F. and drawing at 750° F. showed that the weld deposit had uniformly hardened to RC45-46. The hardness of the parent metal, on the other hand, was RC42 on the outside quenched face falling sharply to RC32-33 at the center of the 1 in. cross section (Table 1). According to the hardness conversion tables, the tensile strength of the parent metal should average about 160,000 psi., whereas the weld should have a tensile strength of about 215,000 psi.

Tensile Tests

Of the five specimens tensile tested, the weld being in the center of each specimen, three broke in the parent metal, two in the weld and none in the "heat-affected zone" adjacent to the weld deposit (Table 2). A similar appearing flaw was observed in the fractures of the two specimens which broke through the weld at tensile strengths of 133,200 and 144,000 psi. In one case this flaw was identified as an extension of the hair-cracks, *B*, observed in the macrophotograph of the specimen shown in Fig. 5.

Table 1—Rockwell Hardness of NE8630 Plate Welded with Planeweld AWF 144-4130 Rod

I. Heat-Treated Weld Assemblies ($9^1/_8$ x $3^3/_4$ x 1 In.) Normalized 1650° F., Water Quenched from 1600° F., Tempered 750° F.

Place of Test	RC
Weld deposit	45-46
Parent metal, quenched surface	42
Parent metal, adjacent to weld, center line of 1-in. section	38
Parent metal, center line of 1-in. section away from weld	32-33

II. Reheat-Treated Specimens Nos. 13 and 14 (7 x 0.9 x 0.27 In.) Normalized 1620° F., Oil Quenched from 1600° F., Tempered 600° F.

Place of Test	RC
Weld deposit	45-47
Parent metal	42-45

Parent Metal RC 38 Weld RC45

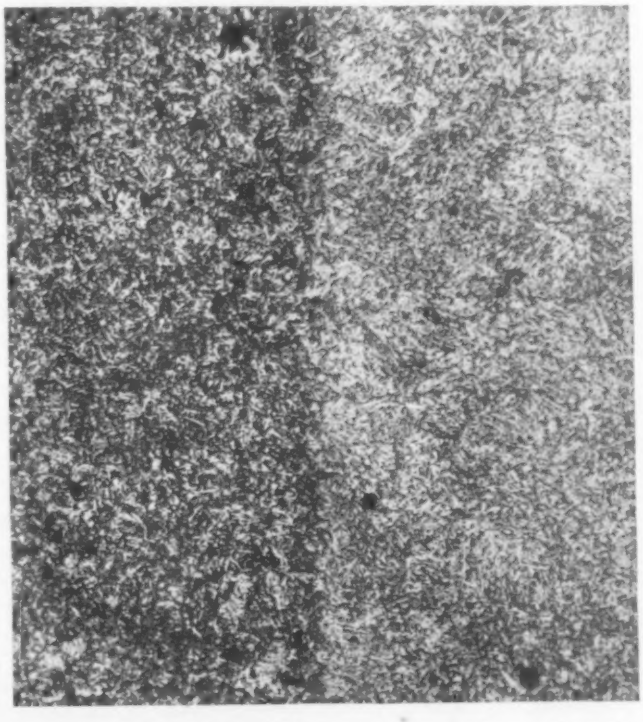

Fig. 6—Microstructure of Transverse Section Through Weld and Parent Metal, Assembly No. 1

Heat treatment: Normalize 1650° F., water quench from 1600° F., temper 750° F., 2 hr. Specimen No. 12. Weld and parent metal are tempered martensite; the latter is finer grained. Etchant: 5% Nital. × 250.

Table 2—Tensile Properties of Assembly No. 1, 1 In. Thick NE8630 Plate Welded with Planeweld AWF 144-4130 Rod

Normalized 1650° F., Water Quenched from 1600° F., Tempered 750° F. 2 Hr.

Specimen No.	Thickness, In.	Width, In.	Yield Strength 0.2% Offset, Psi.	Tensile Strength, Psi.	Elongation in 2 In., %	Place of Fracture
12	0.898	0.307	135,000	144,000	1	Weld
13	0.923	0.266	124,900	149,100	*	At grip
14	0.923	0.266	126,500	148,000	*	At grip
15	0.499	0.349	129,000	133,200	1	Weld
16	0.499	0.442	134,000	159,000	*	Parent metal
131†	0.225	0.224	196,500	226,000	10	Weld
141†	0.225	0.203	194,000	224,000	3	Weld
132†	0.223	0.208	215,900	230,000	10	Parent metal
142†	0.224	0.208	199,000	223,000	10	Parent metal

* Broke outside gage marks. Elongation appeared to be greater than 10%.

† Specimens Nos. 131, 132, 141 and 142 were cut from Nos. 13 and 14 after renormalizing at 1620° F. and reheat-treating at 1600° F. followed by oil quenching and tempering at 600° F. for 1 hr.

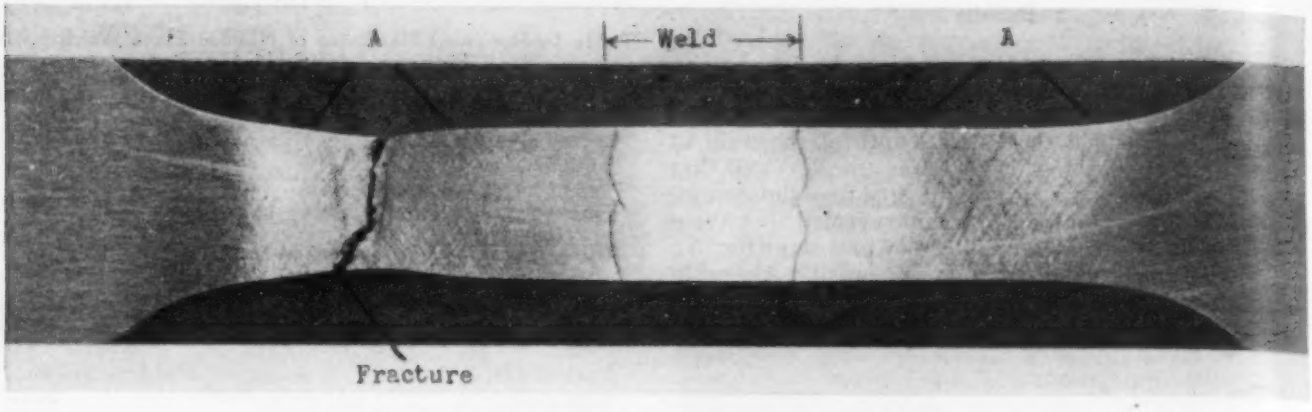

Fig. 7—Tensile Specimen Failure in Parent Metal

Heat Treatment: Normalized 1650° F., water quenched from 1600° F., tempered 750° F., 2 hr. Tensile strength 159,000 psi. Rockwell hardness: weld RC45, parent metal RC32-38. The weld shows no sign of plastic deformation. The NE8630 parent metal has slip lines along the 45° planes of maximum shear stress on both sides of the weld (*A*). Tensile specimen No. 16. × 2.

It should be noted that in three cases out of five the welds were stronger than the parent metal as evidenced by failures outside the welded area which was located in the center of each of these specimens. (Fig. 7 is an example.)

Reheat-Treatment

Rockwell hardness determinations performed on the reheat-treated specimens showed the parent metal to be RC42-45 and the weld deposit RC45-47. The average tensile strengths of these four specimens were 225,000 psi. for the weld and 226,500 psi. for the parent metal, while the per cent elongation in 2 in. averaged 6.5% for the welds and 10% in the parent metal (Table 2 and Fig. 8).

Spectrographic Analysis

The welding rod was found by analysis to be X-4130 steel as stated by the vendor. However, the weld deposit is relatively high in manganese, chromium and silicon introduced by the flux and slightly higher than the rod in nickel acquired from the parent metal. A considerable difference in the alloy contents of the two weld assemblies is also to be noted, Weld No. 2 being lower in the oxidizable elements manganese, silicon and chromium (Tables 3 and 4).

Welding Rod Characteristics

The welders found difficulty in maintaining the arc and in removing the flux between passes. The arc characteristics appeared to be similar to stainless rod and the flux was quite thick.

Discussion of Results

A flawless weld deposit in 1 in. thick NE8630 plate was found to have greater tensile strength than the plate, when the parent metal was heat treated to 160,000 psi. For these specimens, a probable weld strength ca. 215,000 psi. may be deduced from the fact that the weld had hardened uniformly to RC45-46 and the tensile

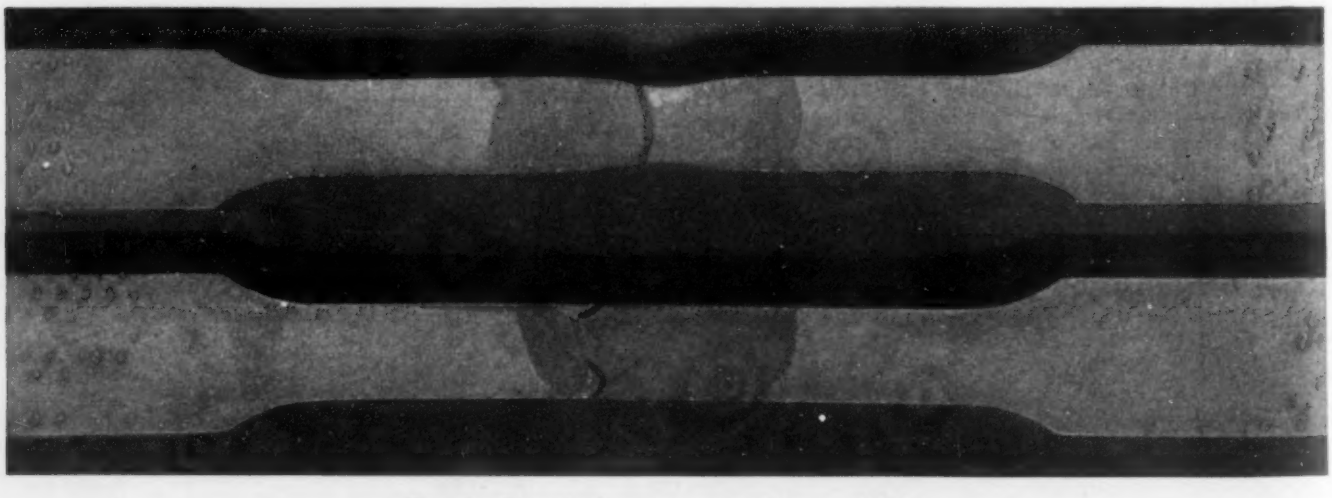

Fig. 8—Tensile Specimens Failure in Weld

Reheat treatment:, normalized 1620° F., oil quenched from 1600° F., tempered 600° F., 1 hr. Specimens etched after tensile testing to reveal position of weld. Etchant: 50% HCl hot, 5 min. × 2.3.

Specimen No.	Tensile Strength, Psi.	Elongation in 2 In., %	Weld	Parent Metal
131	226,000	10	RC46	RC43
141	224,000	3	RC46	RC43

Table 3—Quantitative (Spectrographic) Analysis of Welding Rod, Weld Deposit and Parent Metal

Element	Welding Rod, %	Weld Deposit, %		Parent Metal, %
		Assembly No. 1	Assembly No. 2	
Fe	Rem.	Rem.	Rem.	Rem.
Mn	0.62	2.17	2.34	1.05	0.76
Cr	0.93	1.85	2.02	1.30	0.63
Si	0.27	0.93	0.96	0.46	0.28
Ni	Trace	0.17	0.13	0.21	0.59
Mo	0.17	0.36	0.37	0.33	0.23
C*	0.33	0.22	0.29	0.27	0.35

* Carbon determinations by wet chemical analysis.

Table 4—Analysis (Spectrographic) of Coating on Planeweld AWF 144-4130 Rod

Element	Qualitative Content	Probable State*
Ca	Principal constituent	Oxide
Fe	5.0 –50.0	Oxide and metallic
Mg	1.0 –10.0	Oxide
Mn	0.5 –5.0	Oxide and metallic
Cr	0.5 –5.0	Metallic
Ti	0.2 –2.0	Oxide
Si	0.1 –1.0	Oxide and metallic
Mo	0.05–0.5	Metallic
Ni	Trace	...
Al	Trace	...

* The oxides make the arc protecting flux. The metallics may be pure or ferro-alloys.

strength of the reheat-treated weld was 225,000 psi. at RC45-47. The high strength of the weld in heavy sections is due to its deep hardenability which in turn is attributable to its relatively high manganese, chromium and silicon contents. This excellent weld strength is graphically illustrated in Fig. 7 by the lack of any visible plastic deformation in the weld at 159,000 psi. whereas the parent metal shows slip lines along the 45° planes of maximum shear stress on both sides of the weld, plus necking to failure on one side. It may be deduced from this evidence that the weld had not yet reached its elastic limit when the 8630 steel reached its ultimate tensile strength of 159,000 psi.

The lower tensile properties of the 8630 steel as compared with the weld deposit are due to the shallower hardening properties of the 8630 1 in. thick plate. It therefore appears that this welding rod may be used in conjunction with higher-alloy, deeper-hardening steels having higher tensile strengths in heavy sections. This in turn would lighten the entire structure of the landing gear assembly by reducing the thickness of steel required to produce the necessary physical properties. Moreover, such high-strength welds could surely find extensive use in other industries.

Although the manganese and chromium in the weld are beneficial in increasing its hardenability, these alloying elements tend to produce a steel which is subject to "temper brittleness." This type of low impact toughness occurs after cooling slowly from tempering temperatures up to about 1200° F. and may be avoided by quenching from the tempering heat. The longitudinal crack at the base of the weld in Assembly No. 2 probably occurred during the straightening operation performed after welding, and may have been caused by the straightening being continued after the metal had slow-cooled and become brittle.

The arc characteristics of Planeweld AWF 144-4130 rod were found not to be as favorable as those of a low-tensile strength rod. The two welds, made by similarly instructed, different, certified welders, proved to be vastly different in porosity, retained slag, cracks and chemical analysis. It was ascertained, however, that the poor weld was attributable to incorrect welding technique, as the welder had failed to chip away all of the slag between passes and it was found that the slag produced by the experimental welding rod coating does not readily melt and float away. The good weld resulted after very carefully chipping away the slag between passes. However, it should be noted that the best welding procedure for this rod has not as yet been developed. It appears that the welding factors must be closely controlled in order to obtain consistent results with this rod.

Since Assembly No. 2, which was made with the preheated rods, turned out to be extremely porous and was badly cracked, it was impossible to test these rods under the most advantageous conditions. Generally, preheating welding rod coatings drives off moisture and produces welds of minimum porosity and cracking susceptibility.

Suggestions for Improving the Welding Rod

It has been demonstrated that experimental Planeweld AWF 144-4130 filler rod is capable of producing welds in 1 in. thick sections which can be heat treated to tensile strengths in the vicinity of 200,000 psi. This high-tensile strength results from a relatively high-alloy weld of deep hardenability. However, the combined high manganese and chromium contents of the weld deposit tend to produce temper brittleness, while the relatively high manganese introduces the possibility of cracking if quenched too drastically from the heat-treating temperature. It is therefore suggested that the manganese content of the rod coating be reduced since this is the source of the extra alloy which enters the weld deposit. Excellent physical properties will result if the manganese content remains between 1.0 and 1.30% in the weld deposit.

Because of the great difference in the chemical analysis of the two welds, it appears that the welding procedure and especially the current will require very close control in order to insure reproducible results.

The tendency of the weld to develop gas and slag pockets at the beginning of each pass can undoubtedly be greatly reduced by preheating the rods. However, this tendency, plus the thick pasty quality of the flux when the molten weld deposit is relatively cool, may require the addition of elements or oxides to thin the flux slag and reduce its melting point. Because of the tenacity of the slag when solid, it was found necessary to carefully chip away all of the visible slag between welding passes. This was done in the case of Weld No. 1 with gratifying results.

If the above-mentioned arc characteristics of this welding rod are improved, this new high-tensile strength rod will undoubtedly find wide acceptance and use in aircraft as well as other industries.

Overheating of Electrodes*

By I. L. Stern†

A method has been developed for investigating the tendency of electrodes to overheat during operation. Several deleterious effects which may result from overheating are noted. Application of the method to a specific problem is illustrated.

Introduction

THE question of the selection of the proper lengths to be used in the manufacture of electric arc-welding electrodes has been a topic of frequent discussion and conjecture. It is obviously desirable to use the longest electrode practicable to achieve maximum production rates and minimum stub losses. On the other hand, electrodes will tend to overheat during operation if their length should be too long or the operating amperages employed should be excessive. The object of the work upon which this paper is based was to develop a quantitative method to evaluate the tendency of electrodes to overheat. It was intended to utilize the method to determine the longest length of each particular diameter electrode that could be used without effecting any material change in the composition or characteristics of the electrode coating. Although test work was confined to an electrode whose coating contains a high percentage of organic components, it is believed that the methods developed will be applicable to the study of the overheating characteristics of all types of electrodes.

An analysis of the possible results of overheating indicates that the effects on core wire and coating are entirely different. Heating of the core wire changes the physical and electrical properties of the steel but does not alter its composition. On the other hand, electrode coatings tend to lose moisture almost as soon as heat is applied. At 392° F. (200° C.) decomposition of the organic constituents of the coating is well under way and, upon prolonged heating of the coating at this temperature, deterioration can readily be discerned by the gradual darkening of the coating material. The nature of this decomposition is complex and will not be discussed here. However, the over-all reaction tends to break down the organics into volatile constituents which are lost to the atmosphere and nonvolatile carboniferous residues which darken the coating material. Table 1 lists typical analyses of the common types of electrode coatings containing appreciable quantities of organic constituents. It can be readily appreciated that alteration of the coatings by decomposition of organics and loss of moisture will materially change their composition. Since the chief function of the organics is to shield the molten weld metal from the surrounding air, overheating of an electrode to an extent which will cause appreciable decrease in organic content can be equivalent to using electrodes with inadequate shielding properties. Such electrodes should tend to produce welds of lower ductility and, in some cases, excessive porosity. Changes in the moisture content can alter arc characteristics and may affect the soundness of the resulting weld deposit.

This investigation was directed chiefly toward developing a method for studying the overheating characteristics of electrodes and, by means of the method developed, to study the effects of overheating on the usability characteristics and coating composition of the electrodes. No attempt was made at this time to investigate the effects of overheating of electrodes on the physical properties of the resulting weld deposits. However, test results have indicated that by applying the techniques and testing methods developed, significant information could be obtained along these lines.

* The opinions expressed herein are those of the author and do not necessarily represent the opinions of the Navy Department.

† Welding Engineer, Welding Section, Material Laboratory, New York Naval Shipyard.

Table 1—Typical Analyses of Cellulosic Bearing Coatings

Electrode Type	Per Cent Organics*	Per cent Moisture†
E-6010	25	3–6
E-6011	20	3–6
E-6012	10	3–6
E-6013	15	3–6

* Chiefly cellulose.

† Weight loss when heated at 220° F.

Table 2—Analysis of High Tensile Steel Plate

Carbon	0.16	Copper	0.08
Manganese	1.18	Nickel	0.10
Phosphorus	0.015	Vanadium	0.002
Sulphur	0.030	Titanium	0.02
Silicon	0.28		

Test Materials

Samples from the same batch of $^{7}/_{32}$-in. diameter x 18-in. Grade E-6010 electrodes were employed for all test work. The ratio of coating to core weight of this electrode was 13.4%. When heated to constant weight at 275° F. the electrode coating exhibited a weight loss of 5.31%. Total weight loss on ignition of the coating material at 1600° F. was 27.40%.

All welding operations consisted of depositing single pass fillet welds in 20-lb. ($^{1}/_{2}$-in.) Navy type high tensile steel plate of the analysis indicated in Table 2. Electrical power was controlled by means of a 500-amp. resistance box, which was in series with a 1000-amp., 70-v. open circuit constant potential generator. Thermocouple temperatures were determined by means of potentiometer-type instruments.

Procedures and Results

Test No. 1 was conducted to study the relationship between amperage and temperature of electrode coating

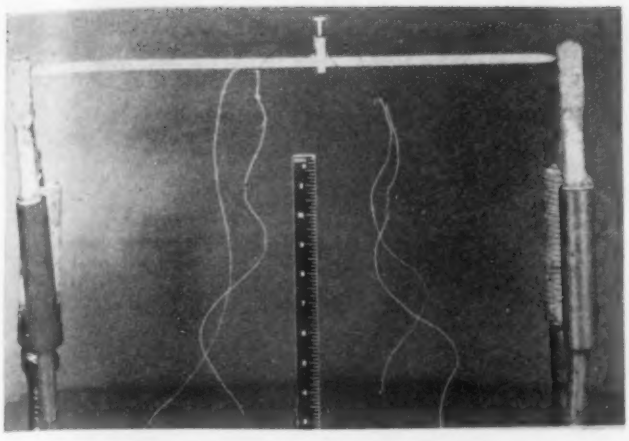

Fig. 1—Test Setup for Heating Electrodes

and core wire. At a distance of 9 in. from the striking end, a No. 69 size hole was drilled through the coating and halfway through the steel core wire. One thermocouple (30 B&S Gage Wire) was inserted to the depth of the hole and a second was clamped in close contact with the coating surface. A current of predetermined value was then passed through the electrode which had been connected to form a short circuit across the terminals of the resistor box. Temperature rise against time was plotted for a period of 3 min. at intervals of 15 secs. In the course of this test, the amperage passing through the electrode decreased 10 to 20 amp. from the pre-set value due to the increasing resistance of the core wire which accompanied the rise of temperature. No attempt was made to correct for this reduction in amperage. Results of this test are shown in Fig. 3. As indicated therein, temperature rise is directly related to amperage and, with the data shown, it is possible to predict the temperature of core and coating of an electrode which is heated by a given amperage for a specified time. It is to be noted that in this test, as in all subsequent tests described, coating temperatures referred to represent surface coating temperatures; the average coating temperature, in each case, lies somewhere between this temperature and the core wire temperature.

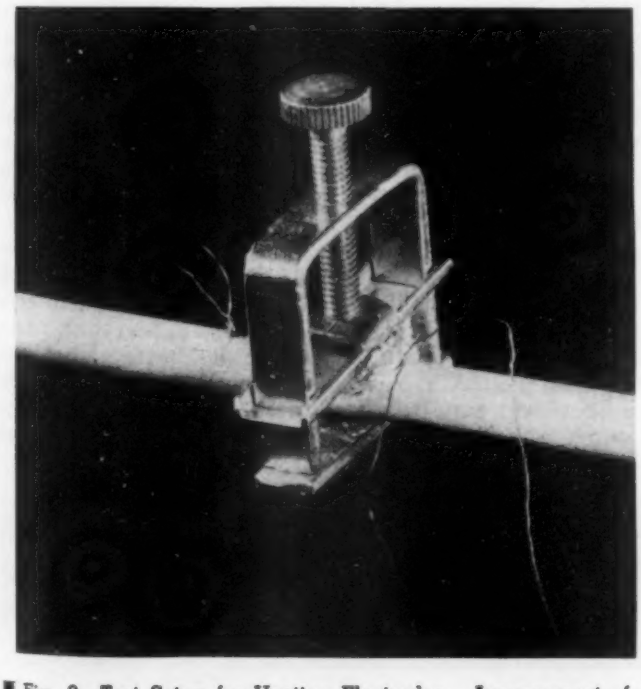

Fig. 2—Test Setup for Heating Electrodes. Arrangement of Thermocouples

If the heating effects of the welding arc are neglected, a good approximation of the electrode temperature after any given time of actual welding operation can be derived from Fig. 3. Preliminary tests indicated that increases in coating temperature resulting from the heating effects

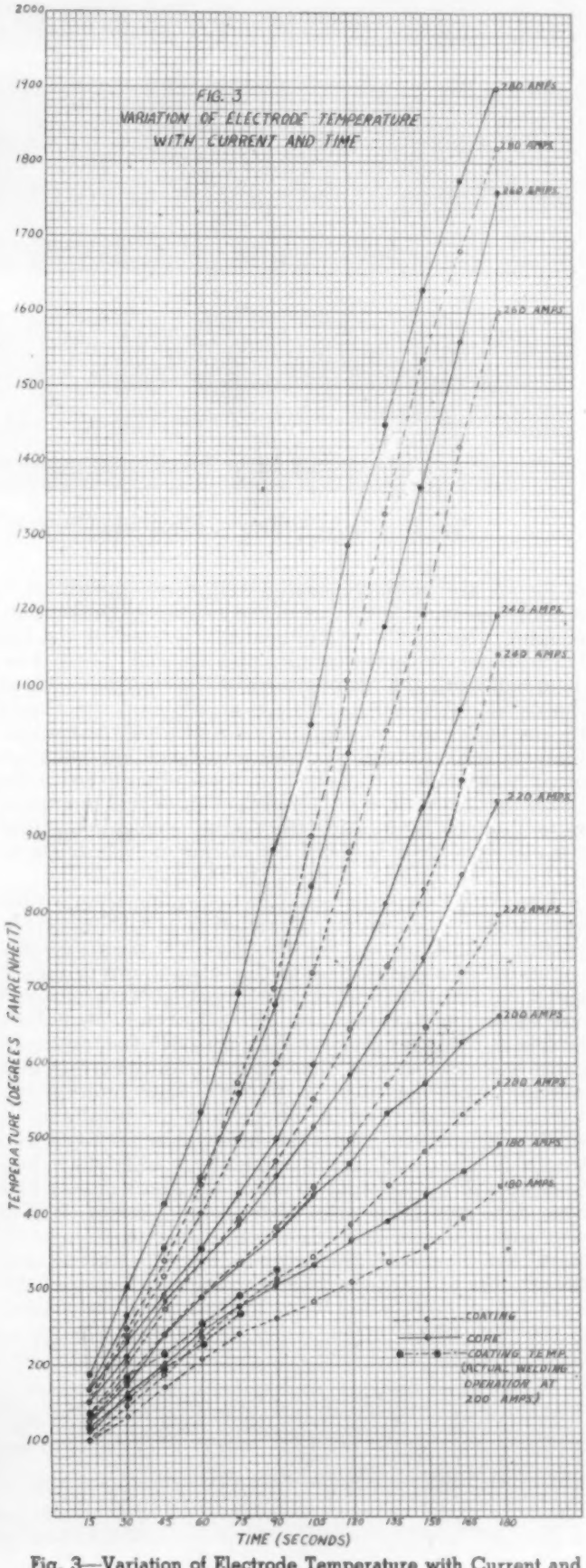

Fig. 3—Variation of Electrode Temperature with Current and Time

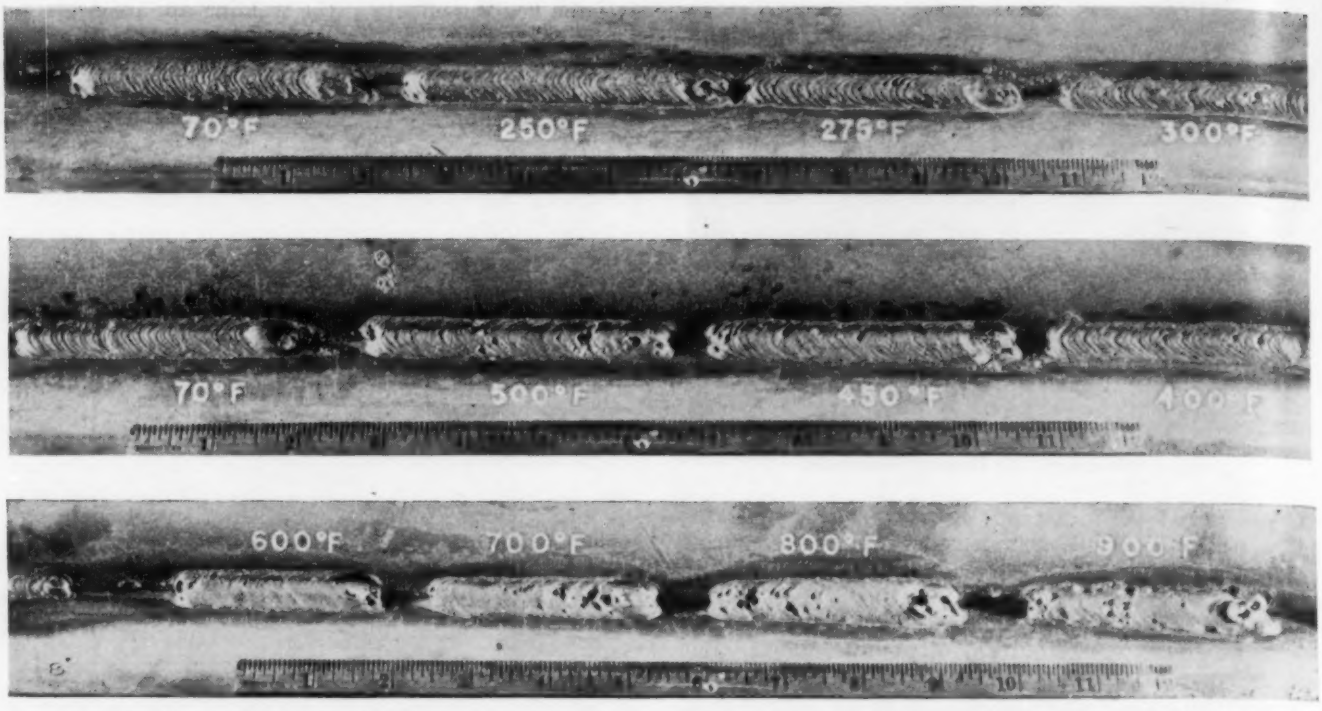

Fig. 4—Effects of Rise of Electrode Coating Temperature on Quality of Weld Metal Deposit

of the arc are relatively small until the arc approaches to within approximately $^1/_2$ in. of the location of the thermocouples. No data were obtained at this time for the last $^1/_2$ in. between thermocouples and arc end. Initial results indicating the temperatures of the electrode coating during actual welding operation at 200 amp. are shown by the heavy dots of Fig. 3. As indicated therein preliminary results obtained under actual welding operation are in reasonable agreement with those obtained with the test setup shown in Figs. 1 and 2. These measurements were obtained by locating the thermocouples 2 in. from the electrode grip end and consuming the electrode to within $^1/_2$ in. of the location of the thermocouples.

Test No. 2 was conducted to determine the possible variations of deposition characteristics with electrode coating temperature. For this test the electrode was connected in a short circuit in the setup shown in Figs. 1 and 2 and 220 amp. passed through until a predetermined coating temperature was attained. The circuit was then broken at the striking end of the electrode; the resistance panel was reset to give a 220-amp. welding current and welding operations were initiated. Time interval between the breaking of the circuit and the beginning of welding operations was kept below 5 sec. After the length of electrode (approximately $^1/_2$ in.) which had been stripped of coating to effect the short circuit had been deposited on a scrap plate, a 3-in. length of fillet weld was deposited on a 20-lb. high tensile steel tee joint. Results of these tests are shown on Fig. 4. As indicated therein, the first adverse effects on the appearance of the weld deposit were noted when the surface of the coating of the particular electrode under test reached a temperature of 275° F. To check the change in deposition characteristics noted between 250 and 275° F., two fillets were deposited at each temperature with 220 amp. Results of this test are shown in Fig. 5. As indicated therein, the change in deposition characteristics again was noted between 250 and 275° F.

The test results decribed in the preceding paragraph are attributed to changes in the condition and characteristics of the coating of the particular batch of electrodes tested. Effects which could definitely be attributed to overheating of the electrode core wire were not encountered until the electrode coating had reached a temperature of 700° F. (core temperature approximately 800° F.) at which time the weld metal deposited at 220 amp. exhibited excessive fluidity. However, even at this temperature, welding operations could be conducted without undue difficulty. Fluidity of molten weld metal and arc instability increased as coating temperature was increased until a coating temperature of 900° F. (core temperature approximately 1100° F.) was reached. At this temperature arc characteristics became so erratic and weld metal fluidity increased to such an extent that operations at higher temperatures were not considered feasible.

Test No. 3 was conducted to determine whether the temperature rise data of Fig. 3 could be correlated with the deleterious effects of rise in coating temperature noted in Test No. 2. Figure 3 indicates that when heated with 220 amp., the electrode coating reaches a temperature of 275° F. in about 1 min. Accordingly 3 in. of fillet weld were deposited after the electrode had been heated with 220 amp., in the manner described under test

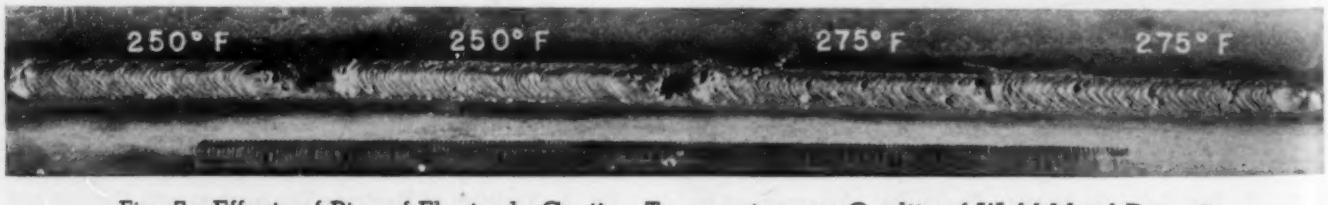

Fig. 5—Effects of Rise of Electrode Coating Temperature on Quality of Weld Metal Deposit

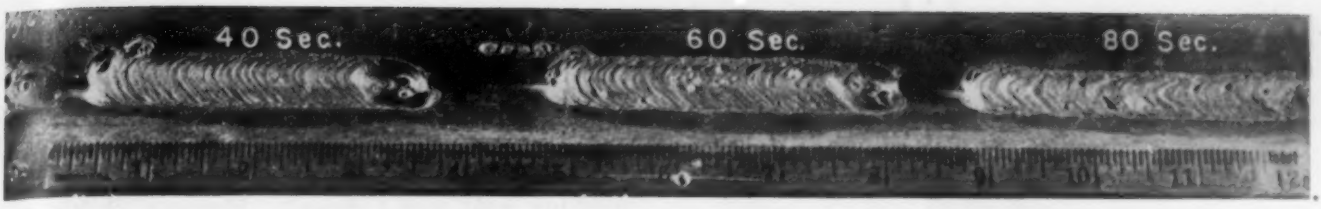

Fig. 6—Effects of Time of Operation on Quality of Weld Metal Deposit

No. 2 for 40 sec., 60 sec., and 80 sec. The length of electrode which had been stripped of coating to effect the short circuit was deposited on a scrap plate immediately prior to depositing the test weld. As indicated in Fig. 6, results of this test are in agreement with those of Tests Nos. 1 and 2, namely, that when the electrode coating is heated for a sufficient length of time for the covering temperature to reach 275° F. or above, deposition characteristics are unsatisfactory.

Test No. 4 was conducted to check the results of the preceding tests. For this test, a fillet weld was deposited at 200 amp., consuming 16 in. of the 18 in. length of electrode. Deposition time was 115 sec. A photograph of the fillet produced is shown in Fig. 7. As indicated therein, initial signs of surface porosity appear after one-half of the quantity of weld metal had been deposited, which corresponds to approximately 58 sec. of operation time at 220 amp. Figure 3 indicates that this time is

Table 3—Observations of Changes in Electrode Coating with Increased Temperature

Electrode—$^{7}/_{32}$-In. Diameter Type E-6010. Heating Current—170 Amp.

	Surface Temperature, ° F.	
	Observer 1	Observer 2
First signs smoke	250	265
Coating starts to darken	360	375
Copious evolution smoke	420	425
Coating entirely darkened	450	450
Evolution smoke stops	710	750
Electrode dull red	750	810
Electrode cherry-red	875	950

equivalent to a coating surface temperature of 280° F. This result is in close agreement with what would be predicted by the data of Tests Nos. 1, 2 and 3.

Test No. 5 was conducted to study the effects of the heating on the composition of the electrode coating. For this test, the setup of Figs. 1 and 2 was again employed, and only electrode surface coating temperatures were recorded. Electrode current for heating was preset at 170 amps. Results of two independent observations are listed in Table 3. As indicated therein, initial signs of decomposition of the solid matter of the electrode coating were detected visually when a surface temperature of 250° F. was attained; the greater part of the combustible

Table 4—Weight Loss of Electrode Coatings

Short Circuit, Amp.	Time, Sec.	Equivalent* Length Electrode Consumed, In.	Actual Wt. Loss Coating, Gm.	Initial Coating Wt., Gm.	% Wt. Loss Coating	Coating Surface Temp.,† °F.
200	65	8.5	0.515	11.772	4.37	260
200	120	15.6	0.642	11.777	5.45	390
220	126	17.6	0.738	11.651	6.33	530
220	126	17.6	1.045	11.553	9.05	530
200	165	21.5	0.863	11.480	7.52	530
240	119	17.9	2.224	11.442	19.43	640
240	119	17.9	2.473	11.790	20.97	640
260	111	17.8	3.177	11.600	27.39	775

* Length which would be consumed in normal operation of electrode at amperage and time noted.
† Calculated from Fig. 3.

elements had been evolved by the time the temperature of the coating reached approximately 750° F.

Test No. 6 was conducted to quantitatively evaluate the weight loss resulting from the decomposition caused by heating. For this test, the electrodes were carefully weighed and then heated by predetermined amperages in the test setup shown in Figs. 1 and 2. The current was then interrupted, the electrode air cooled and weighed. The electrode was stripped free of coating and the core weight determined. Coating weight was derived from the difference between the original weight of the electrode and the core weight; weight loss of coating was taken as the difference in the electrode weight before and after heating. Coating temperature was estimated from the time of heating and the data of Fig. 3.

Table 4 indicates the loss in coating weight, corresponding to each estimated surface temperature, to-

Table 5—Variation of Burn-off Rate with Operating Amperage

Type E-6010—$^{7}/_{32}$-In. Diameter × 18-In. Length Electrode

Amperage	In./Min.	In./Sec.
180	7.2	0.12
200	7.7	0.13
220	8.4	0.14
240	9.0	0.15
260	9.6	0.16

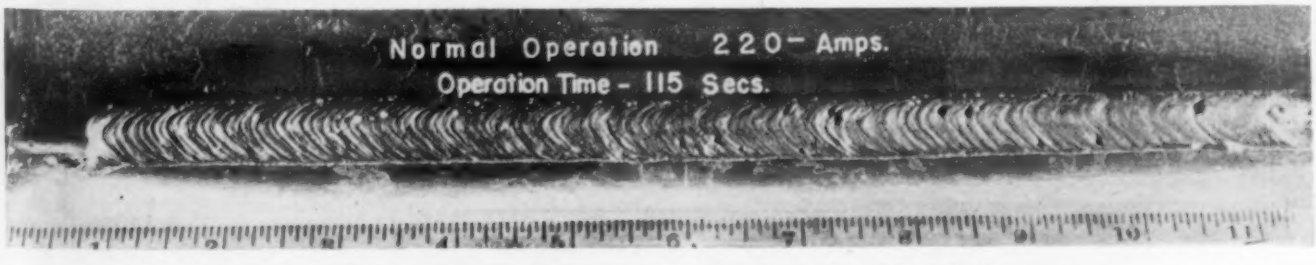

Fig. 7—Effects of Time of Operation on Quality of Weld Metal Deposit

gether with the equivalent lengths of the electrode which would be consumed in actual operation at the times and amperages noted. These equivalent lengths were calculated from the time of operation and the burn-off rates of the electrode which are listed in Table 5.

Discussion

The test results described herein have indicated that, for the particular electrode tested, it was possible to evaluate quantitatively the effect of heating of a welding electrode on the resulting surface appearance of the fillet weld deposit and on the composition of the electrode coating.

With the technique developed it should be possible to determine the maximum length of any electrode which can be used at a given amperage by employing the following procedure:

(*a*) Determine temperature of core wire or coating reached at a given time for a preset amperage. (See Test No. 1.)

(*b*) Determine maximum temperature at which an electrode appears to operate satisfactorily on visual examination. (See Test No. 2.) This will merely indicate effects of overheating on electrode usability. It is anticipated that tests to correlate the effects of overheating of an electrode with the physical properties of the resulting weld metal will be developed and reported at a future date. Should the minimum cellulose content of the electrode coating for effective shielding be known, Test No. 6 may be used to determine the conditions of operation under which the cellulose content does not fall below the minimum.

(*c*) Using Fig. 3 determine the operating time to reach the critical temperature noted in (*b*) above.

(*d*) Determine the burn-off rate of the electrode. The maximum length of electrode that can be used at any given amperage would then be equal to $RT/60$ where R is the burn-off rate in inches per minute and T is equal to the time in seconds determined in (*c*) above.

Test results which have not been reported have indicated that changes in extent of surface porosity of fillets is not associated with overheating of all brands of electrodes. However, the composition of all electrode coatings containing appreciable quantities of organics will be materially altered by being subjected to excessive temperatures. It was the intent throughout the work described to develop a method with which the problem of overheating of electrodes could be studied. Tendency of electrodes to produce surface porosity in fillet welds was accentuated by employing the plate material of Table 1 rather than ordinary medium steel. Likewise the electrode selected for test was very sensitive to overheating effects. No attempt was made to study the effects of the change in composition of electrode coating, resulting from overheating on the quality and physical properties of the resulting weld metal deposit. However, it has been shown that surface appearance of fillets fabricated can in some cases be materially altered. In addition, it is reasonable to assume that the appreciable decrease in shielding characteristics resulting from the decomposition of organics would have an adverse effect on the quality of the weld deposit.

The use of long lengths of electrodes and high operation amperages is frequently employed to obtain high production rates. In those cases where high weld quality is important, consideration should be given to the effects of the change in coating composition resulting from overheating electrodes. It is considered that quantitative information pertinent to the relationship of electrode operating temperature and the physical properties and constituents of the weld deposits should prove helpful in determining the maximum lengths and amperages that can be employed without sacrificing weld deposit quality.

Summary

A method has been developed for investigating the characteristics of electrodes which have been overheated. Using the method developed it is possible to closely simulate the heating conditions which would be experienced by the electrode coating during operation and yet not destroy the electrode in actual operation. The need for additional information relative to the effects of overheating of electrodes on the physical properties of the resulting weld deposits has been indicated.

Acknowledgment

The author wishes to express his appreciation to his coworkers Messrs. J. Bland* and E. DiLiberti† for their helpful suggestions and to Messrs. E. A. Gaudiano* and A. Gleicher* who assisted in conducting many of the tests described herein.

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† Formerly with Welding Section, Material Laboratory, New York Naval Shipyard.

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Maintenance Welding in a Steel Plant*

By Frank J. Gaydos†

MAINTENANCE welding is a broad subject, since it involves practically every phase of welding and, consequently, a knowledge of what should be done and how it can best be accomplished. It has become an essential part of operating repair work and craftsmen skilled in its use are, like those in the electrical crafts, essential in keeping the wheels of industry rolling.

We have all heard praises of welding in mass production and in the production of war material, and how the urgent needs of our country and the rest of the world were met by utilizing the speed and flexibility of manufacture made possible by welding. This record, a proud one, makes all of us happy that our vocation has received the recognition and praise that it deserves.

While these records were being made in the production field, there was an unsung group in the background, without whose efforts the records could not have been established. That group includes the maintenance welders, and they are as important today as they were during the war.

These helmeted and goggled workers seldom had the up-to-date equipment and relatively pleasant working conditions enjoyed by the production workers. They worked in snow and ice, fumes, grease, water, steam and heat, welding and burning in all positions on materials as they came, clean, dirty, or rusty, but seldom the same from one job to the next.

If a furnace or a mill was operating, replacements were hard to get during the war. Operating units had to run and produce. Old equipment had to remain in service. And it had to produce even more than had formerly been deemed possible We can all take pride in the fact that the steel industry broke record after record with equipment that was supposed to have been worn out. The men on the production lines, however, will testify to the effort, initiative and resourcefulness of the maintenance crews. Many times a welding rod in the hands of a maintenance welder plugged the "hole in the dike" and made it possible for a mill to keep going until new parts could be secured or a major repair job accomplished. The war slogan "Keep 'em Rolling" was literally true in our case.

The true worth of a man as a welder craftsman is well demonstrated in his ability to perform the necessary and required work involved in the maintenance of a steel plant. In such a plant, processes range from coke and gas manufacture, the generation of utilities, blast furnace and open hearth operations, to and through primary and finish rolling. By the nature of the operations, the plants are not embodied in a few multi-storied buildings, but are stretched out in single story structures over considerable areas as will be seen in Fig. 1. Field equipment must necessarily be mobile.

At Gary, day-to-day maintenance and field erection assignments are planned the day before. Each department, such as structural, electrical, machine and pipefitting, sends a list of jobs and locations to the welding department. The same practice is followed by the operating units who need welding service for the millwright crews. The field foreman lines up the personnel and makes up a list of machine moves which must be made during the midnight turn. A truck service is maintained by the welding department for transporting men to the more distant locations for emergency repairs and for delivery of oxygen or acetylene tanks, weld rods or other equipment as required or as job needs develop.

Occasionally breakdowns occur and a distraught operator frantically calls for help. It may happen that the field foreman has all available manpower and equipment out on scheduled jobs. He, therefore, finds himself with an intriguing problem of moving men and equipment around like checkers. These are the times when versatility, portability of equipment and ability to improvise are important. We have found that our so-called "doodlebugs" are the kings in this checker play. These units are shop mules with 300-amp. welding generators driven from a power takeoff and equipped with oxygen and acetylene tank carriers, cable reels and containers for electrodes and supplies. The units are of sufficiently narrow wheelbase to maneuver in cramped places.

Such units are more expensive to operate than standard equipment, as is the case with any gasoline-driven equipment because of the cost of tires, motor and drive repairs, gasoline, oil, anti-freeze and other items, but the extra cost is absorbed in savings made in the time involved in getting to the scene of action and in the ability to get a mill back in operation sooner than could be done if conventional equipment had to be brought into action. It is not economical to operate gasoline-driven equipment where welding operations are prolonged, where high amperages are necessary or where electric current is available. In those cases, the "doodlebug" will start a job while a conventional electric motor-generator machine is being trucked to the job and connected to a power

Fig. 1—Aerial View of Gary Works, Carnegie-Illinois Steel Corp.

* Paper presented before Chicago Section of American Welding Society, March, 19, 1948.

† General Foreman, Weld Shop, Gary Works, Carnegie-Illinois Steel Corp., United States Steel Corp. Subsidiary.

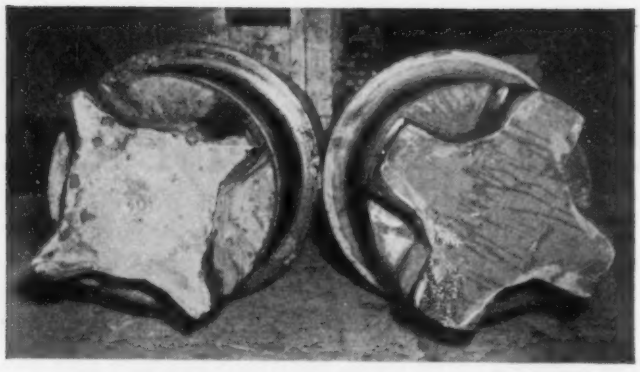

Fig. 2—Left, Effect of Normal Wear on As-Cast Wobbler. Right, Hard-Surfaced Wobbler After Same Service as One at the Left

line. The heavier machine then takes over and the "doodlebug" moved off to another assignment.

The electrodes used for emergency repair work are principally the A.W.S. standard E6012 for low heat input, the E6010 rod to provide more fluid metal for getting through rust and on pipe work, and, since their advent, the hydrogen-free rods now known as E6015 for questionable conditions and use on higher carbon steels and castings.

Optimum welding conditions are seldom encountered. Because of the heat conditions, cooling and lubrication requirements of the operating units, the work places are not as neat as a pin, but are likely to be rather messy even though operators expend much effort to keep their working areas as clean as operations will permit. Under such conditions, however, maintenance welders develop their judgment by working on grease-covered and rusty pipe and equipment. Further, the necessity for working of steels varying in composition from 0.08 to 0.80% carbon requires a detailed knowledge of rod types, techniques and procedures.

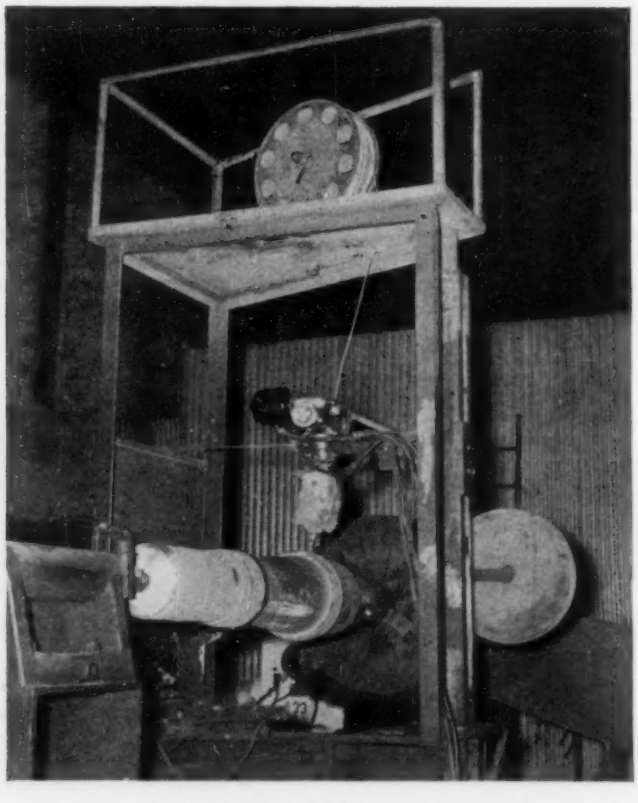

Fig. 3—Circular Pieces Are Built Up in a Lath Equipped with an Automatic Welding Head

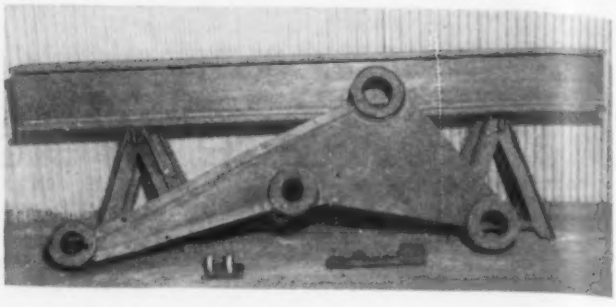

Fig. 4—A Few of the Many Large and Small Fabricated Pieces Assembled by Welding at the Gary Plant

The ultimate goal of maintenance welding is not merely to get the mills fixed, which may be taken for granted, but is rather to prolong the life of mill elements, to eliminate breakdowns as far as possible, to avoid mill delays, expensive repairs and replacements and, in general, to strive for still further progress in the field of preventive maintenance.

Preventive maintenance is a goal which requires the cooperation of all the service departments and the operating units. It starts on the drafting board and is followed through by attention to detail and usage in the various shops. Careful follow-up by the mill operators is essential to check results. And also, it demands study and the fortitude required to experiment without giving up when the going gets tough. If medical and biological research can increase the life-span of man, who represents the most complex and delicate piece of machinery on earth, surely good maintenance research can increase the life of machinery such as we have in our mills.

In a steel mill, this constant job of conquering wear and tear is at once our most intriguing problem and our biggest headache.

When ingots weighing tens of tons are rolled or forged to form a product, huge machinery is required. The pressures are intense, and consequently wear, shock and impact are all abnormal. Steel mills do not operate as smoothly as a fluid-drive car, but create impacts amounting to millions of pounds. Many mill elements are not designed to fit in terms of thousandths of an inch, but rather are assembled on the basis of what an idealist would term a "sloppy fit." This can be accounted for because of the magnitude of the units themselves and the necessity of being able to make changes and repairs quickly and easily, even though there are attendant disadvantages. Thus, the so-called "sloppy fit" is largely responsible for severe impact and abrasive action in connection with spindles, coupling boxes, pinions, rolls and other heavy mill parts.

Figure 2 illustrates what happens on the wobblers of a 36-in. slab mill roll. The two rolls went into service at the same time, but one had hard-faced surfaces while the other was used "as cast."

Prior to a study as to how to overcome this terrific wear, hundreds of welding hours were spent in building up wobblers like these, which was a tedious welding job that had to be done four or five times during the life of a roll. It is easy to say that hard-facing was the obvious solution, yet many times such obvious solutions escape our attention when we are busy with our routine duties, or when we hesitate to try a new idea.

Achieving a satisfactory result, however, took considerable study, for the build-ups had a tendency to pull away from the 0.35 to 0.40% carbon steel used in the wobblers. After some study, we discovered that the trouble lay in the base metal itself. The parts being built up had been under continual impact and the metal was in

fatigue. This condition was overcome by scarfing off this battered metal and building up on good solid base metal. Generally about $^3/_4$-in. of metal was removed before the minute stress cracks were removed and a solid base exposed. We then build up with a 0.25% carbon E6012 electrode and finish off with a pass using a moly or nickel-manganese steel electrode.

In work of this character, welders must adhere strictly to templet sizes after properly centering their layout, and then grind the work to size. This care in rebuilding eliminates the necessity of machine work. One reconditioning now lasts the life of the roll and since much of the wear and tear is avoided, as well as torsion of the operating parts being lessened, the mill operates more smoothly. This, in turn, plays its part in increasing mill performance and quality, and certainly in reducing repairs and breakdown losses in operation.

Preventive maintenance is important in this connection, for it is not necessary to wait until the wobblers are worn to knife edges. Hard-facing can be readily applied to a new wobbler before it goes into service by merely scarfing off the foundry mold crust and applying one, or at most two, passes of hard-facing material.

Another hard-facing application, to combat combined pressure and hot abrasion, is in connection with slabbing and blooming mill hydraulic shear knives. These knives are 6 in. thick, 65 in. long and 12 in. wide. They were formerly made of various alloy steels and had a life of approximately 10,000 tons of sheared product. Before the war, shearing operations were mostly on ordinary carbon steels. During the war, however, it was necessary to handle alloy steels and armor plate, which played havoc with the knives. The problem, however, was solved by replacing the alloy knives with 0.45% carbon plate, one edge being undercut $^1/_8$ by 1 in. on the side and bottom faces and overlaid with a single pass of hard-facing material. Knives fabricated in this manner sheared 60,000 tons of difficult-to-shear products.

Tong bits, used in stripping ingots from molds, formerly lasted only 8 hr. and sometimes less. These bits were redesigned at points of highest stress and the contact edge hard-faced. This treatment increased the life of the bits to approximately 320 hr. of usage. With the additional life, higher tong pressures were realized, which greatly decreased the percentage of "stickers." This, in turn, cut stripper operation time, which allows the ingots to get to the soaking pits at higher temperatures.

The foregoing are merely a few examples of preventive maintenance work involving the use of hard-facing applications. All around will be found chances for improvement. Those mentioned were big jobs, but one should not forget the small parts, guides, dies, pusher rods and similar pieces where the application of a little "blob" of hard-facing will save time and assure smoother operation by increasing the life of a piece.

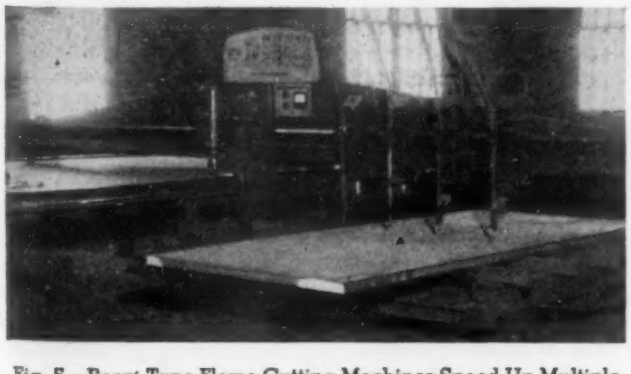

Fig. 5—Boom Type Flame Cutting Machines Speed Up Multiple Cutting Operations of Production Parts

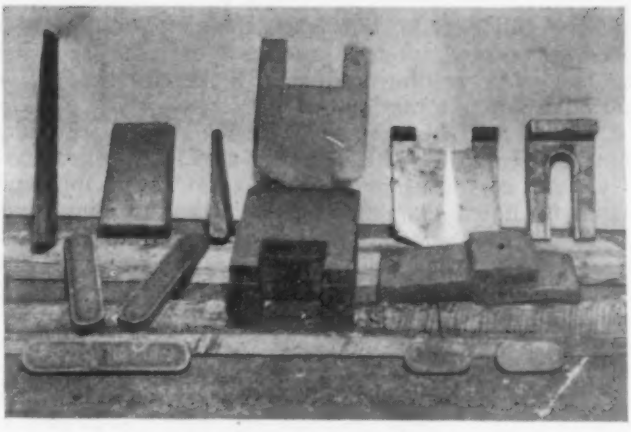

Fig. 6—A Few of the Flame-Cut Sections Produced in the Gary Plant

Hard-facing problems are not too easily solved, nor is any one rod the panacea and cure-all for wear problems. Each application needs study and experiment to develop proper base materials and the correct electrode or rod, preheat, postheat and welding procedure. Sometimes a low-priced rod will do the job, while at other times rods costing several dollars a pound are necessary. Proper usage and application, however, often make the higher priced rods the least expensive. These are some of the challenges encountered in maintenance welding and their solutions are rewarded by increased production and savings in product cost.

Repair of wear on bodies and journals of table and guide rolls needs consideration of such things as marking of the product, necessary coefficient of friction for transport, heat of the product and the reaction of bearings. For these reasons, build-ups generally should not exceed 250 Brinell hardness, and 200 is better.

In most instances the elements being built up are round. Manual build up commonly results in uneven contour, creating high and low spots and a tendency to overweld. This condition is detrimental to machine tools and consumes too much machine time in finishing the work.

A lathe of sufficient swing and length to take a large part of the work encountered, equipped with an automatic welding head, is ideal for handling these circular jobs. Such a unit is shown in Fig. 3. Its use will produce savings of up to 60% of the labor costs in weld metal deposit alone although the wire cost is slightly higher. Most of the work at Gary is built up with wire depositing a 0.25% carbon overlay although some applications of harder metal are made. This type of build-up is sufficiently hard to take care of normal requirements of wear, friction and machinability. The deposit is uniform and concentric, with bead layers overlapping nicely, and produces an easily machined surface.

The steel mill maintenance department will of necessity perform welded fabrication work. A few examples are shown in Fig. 4. Many patterns are scrapped after years of disuse, so replacements are commonly fabricated of steel plate. Likewise, engineering progress has developed the use of more and more fabrications by welding. When drawings originally made for castings are used, the layout and assembly men must be sufficiently trained to convert them intelligently into plate fabrication. In this conversion work, one has to have an open mind and be willing to throw the quirks, time-honored customs, and foundry practices out of the window. Welded fabrication resolves itself into simple elements, but if changes are made, the field conditions must be checked if satisfaction is to be assured. Most welding

jobs are tailor-made, but when quantity or repetitive items are ordered, modern practice is to make use of jigs and automatic welding equipment to increase production and hold cost to a minimum.

Portable and boom type (Fig. 5) shapecutting machines are important tools around a shop. Rolled steel of various compositions is used to produce shapes and blanks for finish machining and final heat treating, such as gear, sheave and pulley blanks, pipe flanges, liners, wearing plates, pug mill blades and similar items. A substantial saving was made in our shop by shape-cutting entry and delivery guides, which are used by the thousands in the rail and merchant bar mills to guide the product being rolled through the various mill passes, each rolled section and pass having a guide for its peculiar shape. These are flame-cut from 0.45% carbon plate. Formerly these guides were forged, at a substantial cost per piece. Shape cutting, however, results in low unit cost per guide, especially if multi-torch cut. Likewise, the operators are able to obtain guides on short notice, which affords them opportunities for greater flexibility of rolling schedules. Another example of the application of multi-torch cutting is in the production of steel wedges $1^1/_2$ by $1^1/_2$ by 6 in. long which are used by the thousands in connection with the stripping of ingots. Figure 6 shows a few of the many flame-cut sections which we produce.

The foregoing few examples will serve to indicate how the maintenance welding department has become a vital cog in smooth plant operations. Sometimes the result is seen directly; at other times the result is indirect.

Cast Iron*

CAST iron as an engineering material has grown increasingly important in the past decade because of its low cost and its many desirable properties. Modern research, too, has greatly improved the quality of available irons and made their wider use possible.

Cast irons are alloys of iron which contain so much carbon that in the as-cast condition they are not malleable at any temperature.[1] Their low melting temperature and marked fluidity permit the use of simple melting and casting procedures, and make it possible to produce useful shapes economically.

Chemically, ordinary cast iron consists principally of six elements; approximately 93 to 95% iron, plus carbon, silicon, manganese, phosphorus and sulphur. These constituents may be present in the following approximate amounts: carbon 1.75 to 4.5%, silicon 0.5 to 3%, manganese 0.5 to 1%, phosphorus 0.15 to 1% and sulphur upward of 0.05%. Most irons contain about 2.5 to 3.5% carbon. Carbon may be present in cast iron uncombined as graphite, as combined carbon (Fe_3C, cementite),† or as a mixture of the combined and uncombined forms.

Cast irons may be classified into the following groups:[2]

Pig Iron: the product of the blast furnace in which iron ore is reduced by means of carbon to the "pig" material. This is used for remelting into refined cast iron or steel.

White Iron: contains carbon almost entirely in the combined form and is produced by rapid cooling of controlled compositions; it is hard, brittle and difficult to machine.

Malleable Iron: produced when white iron is specially annealed and then held at subcritical temperatures. It consists of ferrite† and nodular temper carbon, and possesses properties comparable to low-carbon steel.

Gray Iron: contains carbon principally in the uncombined flake-like form, graphite.

The addition of relatively small amounts of nickel plus chromium or of molybdenum greatly strengthens the resulting alloy cast iron. High percentages of nickel and chromium produce austenitic non-magnetic iron with increased corrosion resistance. The addition of about 14% silicon to cast iron produces a silicon iron of exceptional corrosion resistance. One authority has termed cast iron "iron plus graphite." The latter component is uncombined and undissolved in the metal and does not add any strength to it. In spite of this, the gray irons, because of low relative cost, find wide use where the properties of the metal suffice for service conditions.

Gray irons have strengths from 20,000 to 60,000 psi., depending on composition and cooling rate. Increasing carbon and silicon content and slower cooling favor the formation of graphite and consequently reduce the strength of the iron. These irons have high compressive and shear strengths and excellent wear resistance. The graphite content appears to act as a lubricant in machining. Shock resistance is low as judged by conventional impact tests; however, gray irons of higher strength have stood up well in many services under moderate shock loads. Cast irons have a very high capacity to absorb energy; this so-called "damping" property makes them valuable in moving parts where natural periods of vibration may cause extremely high stresses.

With increasing use of cast iron, the need for welding this metal occurs more often. One authority[3] divides such welding into three principal categories: (*a*) salvage of defective casting in the foundry; (*b*) maintenance and repair; (*c*) fabrication welding. The first two of these have been employed for many years; the latter is a comparatively new technique and not much information is yet available on the subject.

Cast iron may be welded by the gas or metallic arc method. Preheating‡ is very important, as it serves to reduce hardness in the weld deposit, to lessen hardness in the heat-affected zone and to reduce stresses. Preheat temperatures of 1000° F. are recommended for gas welding.‡ Fluxes are necessary when using uncoated rods but flux-coated rods are available.

For electric arc welding, both ferrous and nonferrous coated electrodes are on the market. The former results in extremely hard brittle deposits if preheat‡ is not used, whereas the non-ferrous deposits are soft. However, in either case a brittle martensitic region is formed in the heat-affected zone of the cast-iron base metal if no preheat is used. This introduces the danger of cracking, as well as extreme difficulty in machining. A preheat of 500° F.‡ minimum is therefore commonly used. For heavy sections, higher preheats up to 1000° F.‡ should be used.

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2. Bornstein, H., and Bolton, J. W., "Cast Iron," *Metals Handbook*, A.S.T.M., 617–640 (1939).
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* Taken from *Tempil° Topics*, 3 No. 5 (May 15, 1948).

† See TEMPIL°, "Basic Guide to Ferrous Metallurgy," for definitions and boundaries of critical temperatures. This 16- x 21-in. plastic-laminated wall chart in colors is available on request.

‡ TEMPILSTIKS° are a convenient way of measuring these temperatures. Sample TEMPIL° PELLETS on request.

Fabricated Diesel Engine Structures*

By C. B. M. Dale†

Article includes an historical account of a redesign of a cast iron Diesel engine with a complete interchange of parts with either castings or welded steel parts.

Introduction

FOR MANY years my company, Petters Ltd., has manufactured oil engines which have acquired an international reputation in reliability, economy and performance, especially since 1937 when the Petter Superscavenge Two-Stroke Oil Engine operating on the now well-known Kadenacy system was introduced. Actually, this engine type was the first successful commercial application of this system.

This engine is manufactured in a standard range of from 2 to 6 cylinders, $8^1/_2$-in. bore by 13-in. stroke, developing 96–104 bhp. per cylinder at 600–650 rpm., thus covering a power range of from 192–624 bhp. The engine operates on the two-stroke cycle, the brake mean effective pressure at the above powers being 85.88 psi. for the British Standard Specification 12 hr. rating. Fuel consumption at these rated powers is 0.38 lb. per bhp.-hr. with an invisible exhaust, and the lubricating oil consumption guaranteed is less than $1^1/_2\%$ of the fuel used at full load.

The engines are also offered as marine propulsion units with an oil-operated reverse reduction gearbox, and as a Diesel-electric locomotive unit, and for various duties as with heavy excavating machinery and ship's auxiliary generating sets. Fabricated construction is used very largely in the manufacture.

* Data and illustrations from a study submitted to The James F. Lincoln Arc Welding Foundation in its recent $200,000 Design-for-Progress Award Program for reports and advances and improvements made by the applications of arc welding in design, fabrication, construction and maintenance.

† Chief Engineer, Petters Ltd., Loughborough, England.

The Adoption of Fabricated Construction

From its inception in 1937 until about 1942, in accordance with then current British and European practice, the engine structure was made mostly of heavy cast-iron parts. During the war, however, the supply of these large castings, which are particularly complicated on two-stroke engines, became increasingly difficult. Owing to the diversion of labor for military and more urgent munitions service, the dearth of skilled molders in the foundries became increasingly acute. This situation is just as severe today, two years after the end of the war.

From 1941 to 1942, the author was compelled by urgent circumstances to overhaul the designs completely with a view toward avoiding complicated and heavy castings in favor of fabricated steel. Although considerable knowledge and practice of fabricated structures has been acquired by the large marine engine builders in this country, such as Doxford and Vickers-Armstrong, relatively little was known of the technique of welded fabrication as applied to the smaller medium speed engines of the general class described. It was known, of course, that General Motors Corp. in the United States had extensively used fabricated construction on the Electromotive Winton engines of similar type and sizes, and also that M. A. N. Deutz and other German concerns were applying fabricated construction very extensively. However, the author had had no personal experience and only second-hand information of doubtful value was available.

Interchangeability with Castings

Furthermore, it was axiomatic in any change of design that production must not be interrupted for one moment and that the fabricated structures themselves must be

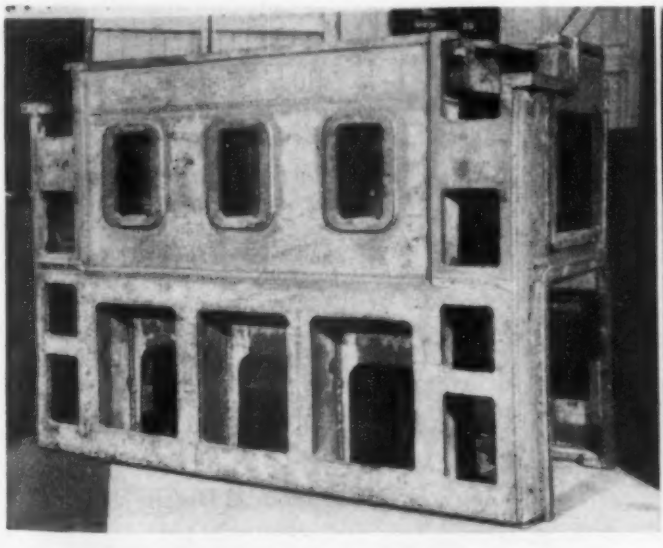

Fig. 1—Crankcase Structure

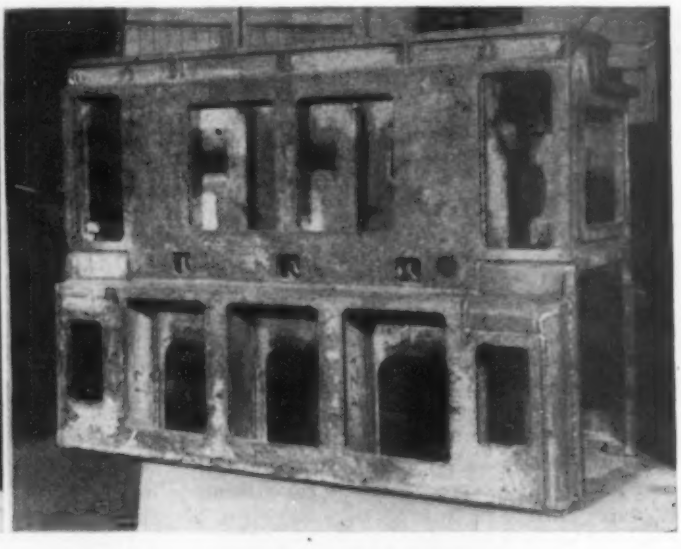

Fig. 2—Crankcase Structure

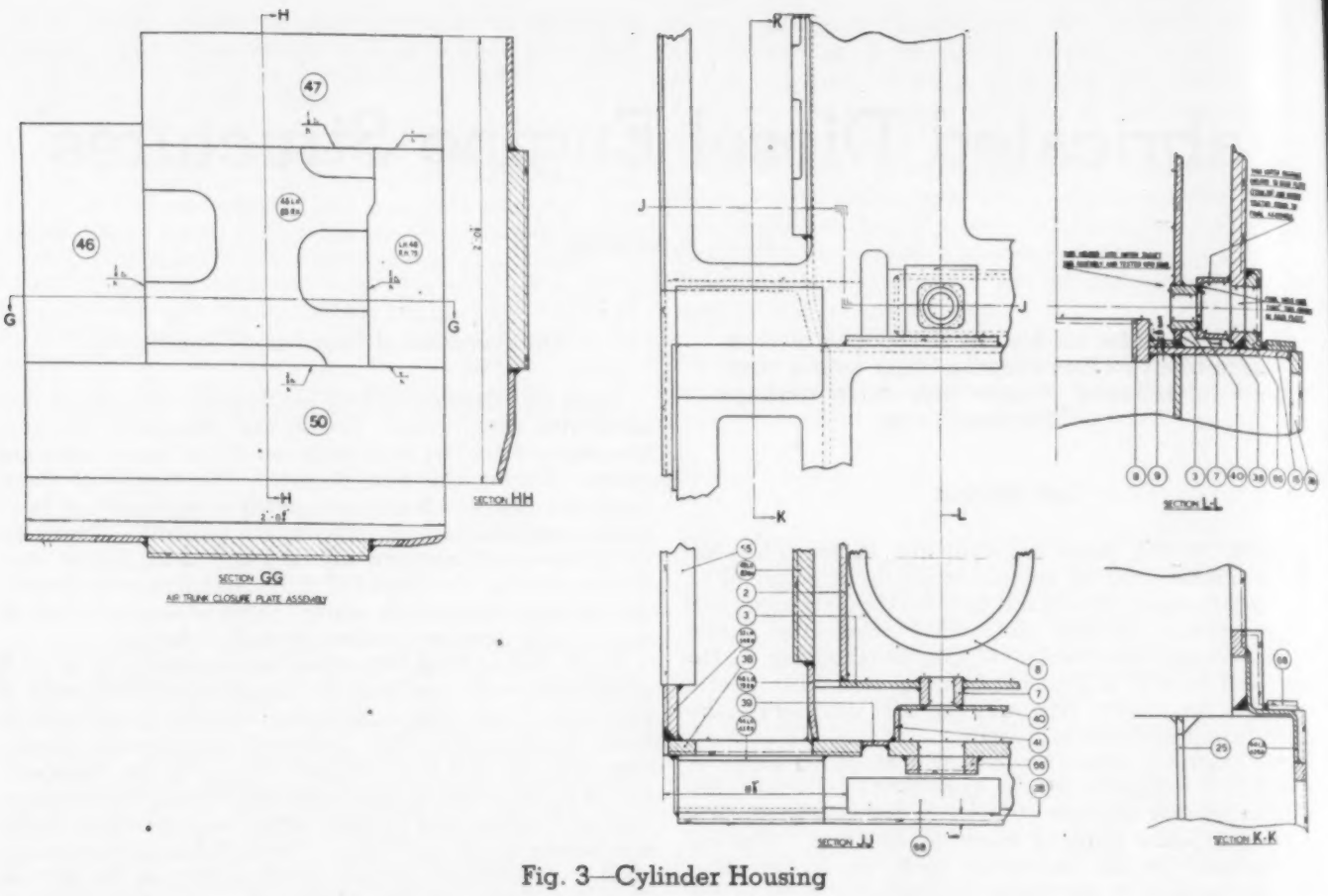

Fig. 3—Cylinder Housing

strictly interchangeable in every respect with the castings they had to replace; thus, the pre-existing jigs and tools might be used without alteration. For servicing purposes, also, it had to be possible to send to a breakdown a fabricated part which might fit exactly in the place of a cast part. Finally, castings and fabricated parts had to be used together. For instance, a cast bedplate might be used with a fabricated crankcase or column and vice versa.

To add to the formidable task owing to the supply position, to military and to other considerations, the over-all weight had to be reduced. The utmost economy was also called for in the use of steel plates.

At the same time, the power and speed of the engine were continually being improved and increased. During the years when this change was first considered, the power was raised from 75 bhp. per cylinder at 500 rpm. to 96–104 bhp. per cylinder at 600–650 rpm., an increase of 39% in bhp. output and 30% in speed. Development work was and is now, being pressed on to 750 rpm. or a further 15%, together with an increase in power to 120 bhp. per cylinder.

Production Conditions at the Beginning

Faced with these serious problems, at a time of great stress and difficulty, with depleted staffs and the general effect of enemy action, the prospects were viewed with much misgiving. The first step was to prepare a design to the best of our ability. Here we were assisted by the fact that the factory already had a fabricating department. It was, however, largely committed to other vitally urgent tasks. Furthermore, equipment was out of date. Also, the personnel had no intimate knowledge of the specialized technique necessary for handling highly stressed structures such as are encountered on Diesel engines.

Preparatory Steps

The aid of the Ministry of Supply Advisory Service on welding was obtained; they criticized the designs and afforded much valuable assistance. The help of welding specialist firms also was sought. The senior designer in charge of the work of conversion was sent to one of the excellent courses in practical design and welding techniques. An attractive feature of these courses was that the designer had actually to undertake welding processes himself and to make a successful job for the work, thus leading to the difficulties of the man on the shop floor with whom he would ultimately have to cooperate.

A young man of university education and high intelligence and aptitude who had received welding and metallurgical training was placed in the fabricating department as a technical adviser. One or two key men on the shop floor were sent for practical training. As many of the engines manufactured were built to Lloyds Survey or Admiralty requirements, efficient welding techniques and rigid inspection of the work had to be developed.

Use of Wooden Models as an Aid to Study

During the preparation and after the designs had been thoroughly "vetted" as indicated, wooden models of the most difficult parts were made. These were exact replicas in detail of each major structure. The pieces were made of the exact size of each plate to be used, and so assembled. All concerned, therefore, could study the models to see how the programs of operation could be carried out in the best manner.

General Constructional Details

To take the stresses directly from the cylinder head bolts to the base of the structure, a box-form water jacket

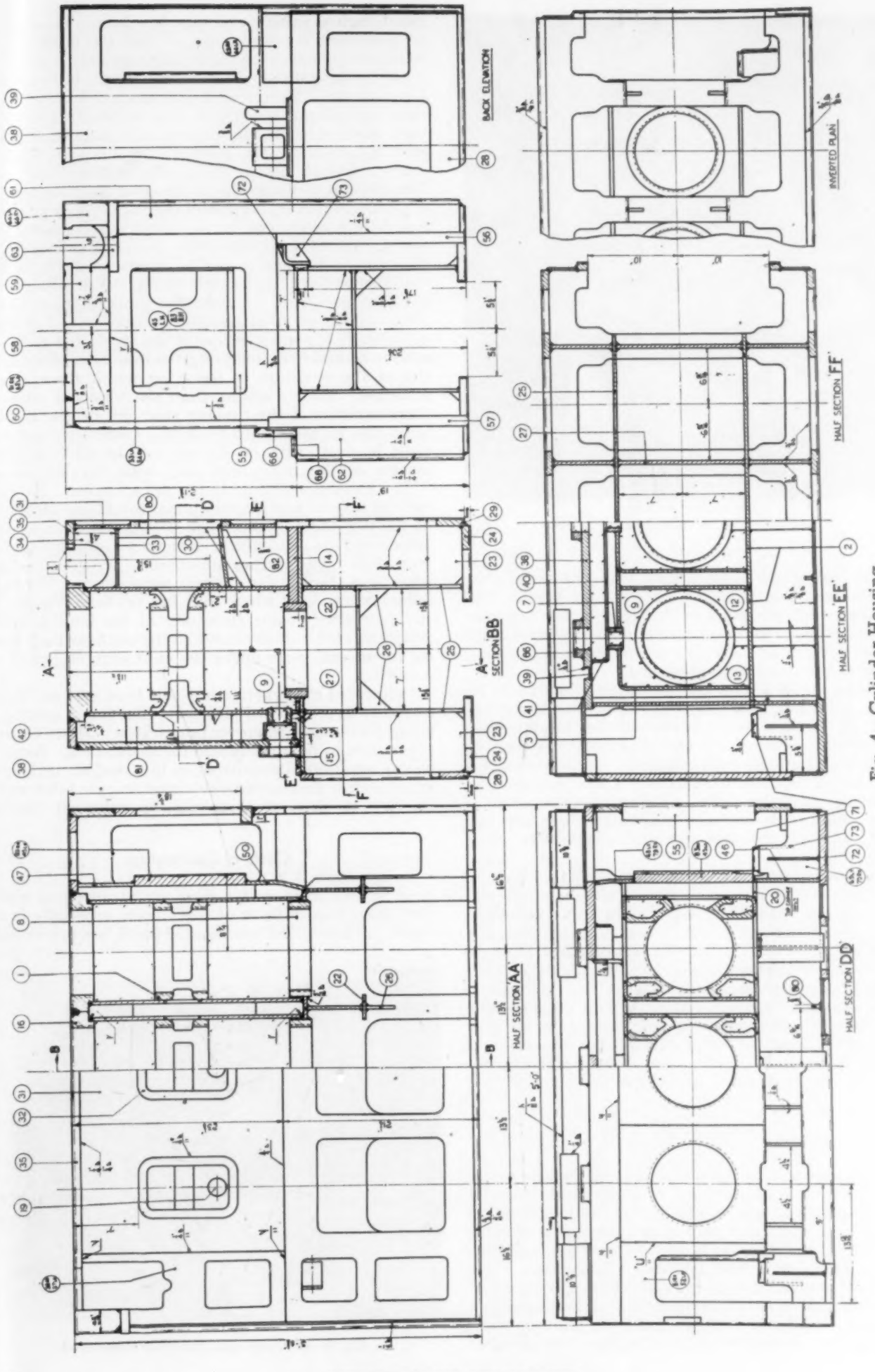

Fig. 4—Cylinder Housing

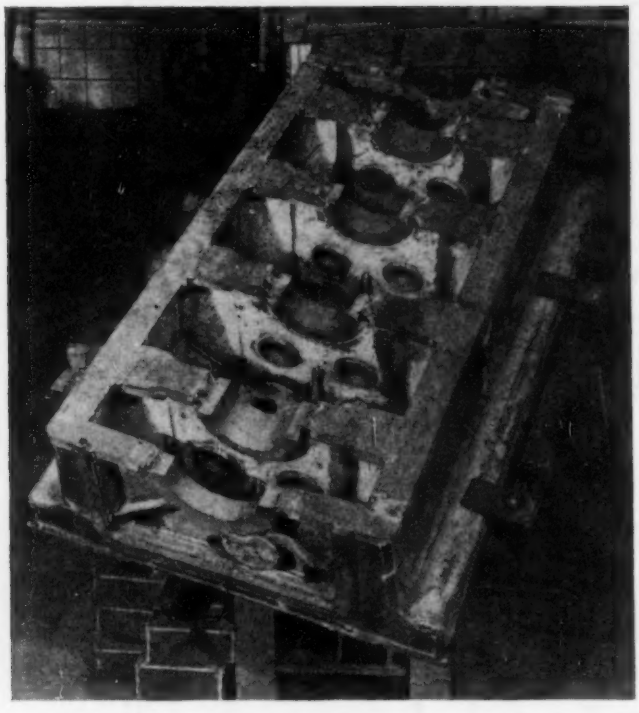

Fig. 5—Bedplate

was devised, which is built up of two continuous plates suitably bent and pierced with holes for the air inlet. Into this middle portion is welded a low-carbon steel casting, which forms the complicated air port section in the middle of the liner. By this means the necessary continuity of the structure is preserved.

Figures 1 and 2 show the crankcase structure in full detail. Starting from the top down, the latter is a heavy plate, built to carry the cylinder head holding-down studs. The cylinder jacket sections previously described are separately subassembled. The lower portion, which forms the actual crankcase, is also subassembled previously, and the jacket sections are welded to it.

The outer walls and the camshaft trough are then added; various trimmings and fillets complete the structure.

The drawings are prepared absolutely complete in every detail. Specification sheets are prepared with them, together with detail and development drawings for each piece of steel as shown in Figs. 3 and 4, inclusive.

The bedplates of the engine call for no particular comment, being well defined in Fig. 5. The method of forming the center sections is interesting. These are made of box sections and "joggled" plates to ensure great rigidity; thus, stress ribs from the bearings, a feature of the castings, are avoided. Photographs of the crankcase or column and bedplate castings are shown for comparison in Fig. 6; the appearance is identical.

General

At the present time, provision is made for fabricating engine structures at the rate of 48 cylinder lines per monthly period of four weeks (13 monthly periods per annum). Most engines built have three and four cylinders; the six-cylinder unit is next in frequency, and there are relatively few in two- and five-cylinder sizes. The fabricating department has been largely reorganized with new welding, pantograph flame cutting and manipulating machines. Adequate facilities exist for plate bending, pressing, etc. A number of minor engine parts are fabricated, such as valve rockers and brackets. These call for no particular comment, except that the fabrication of small components is on the steady increase.

One feature of the fabricated structures, however, calls for criticism. This refers to the general level of engine noise and vibration. There is undoubtedly a tendency for fabricated engines to be more noisy than engines with cast iron main parts. "Drumming" is eliminated, of course, through the use of suitable stiffeners and pads. Harshness is probably due to the poor damping capacity of steel. Similarly, because of the characteristics of steel, a slightly greater tendency to vibration effects has been noted. Here, again, care must be taken to incorporate stiffeners at the right places. Unfortunately, no definite rules can be given. The author's procedure is to run over the structure with a Cambridge Vibrograph, recording the intensity of vibration, and to take remedial action accordingly. Some care in the interpretation of the results is necessary in analyzing the resonance characteristics of the structure or frame on which the engine is mounted. Effects arising from the torsional vibration characteristics of the running gear and driven machine must also be taken into account. Generally, each case must be dealt with on its merits. In addition, audiometer devices have been used with varying success.

The ideal would be to design a new engine. For commercial reasons and for the special conditions mentioned at the beginning of this short paper, this is impossible. Improvements can only be introduced step by step as, and when, opportunities are offered. Progress is somewhat slow, but so far entirely satisfactory. No single failure of any kind whatsoever has yet been reported on any fabricated engine structures of the kind described and illustrated. Many hundred engines have been working for several years under the most arduous conditions possible.

Fabricated construction has now been adopted by the company as a standard practice. The use of castings is being discouraged wherever practicable. Many castings yet remain to be investigated for fabrication. Some, of course, are quite inamenable to this modern technique, but it is clear that considerable economies in labor and in delivery of finished parts can be achieved thereby.

Costs of Fabrication

As regards costs, so far these are about equal with a very slight bias in favor of fabrication, especially in the case of the heavy and complicated parts, where core mak-

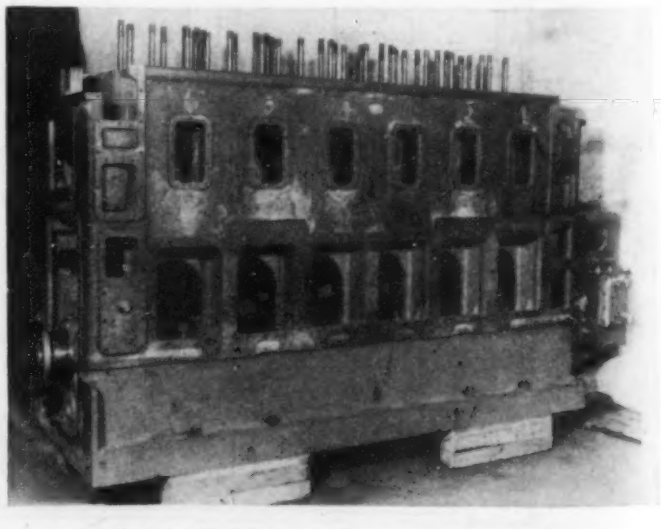

Fig. 6—Bedplate and Crankcase Assembled

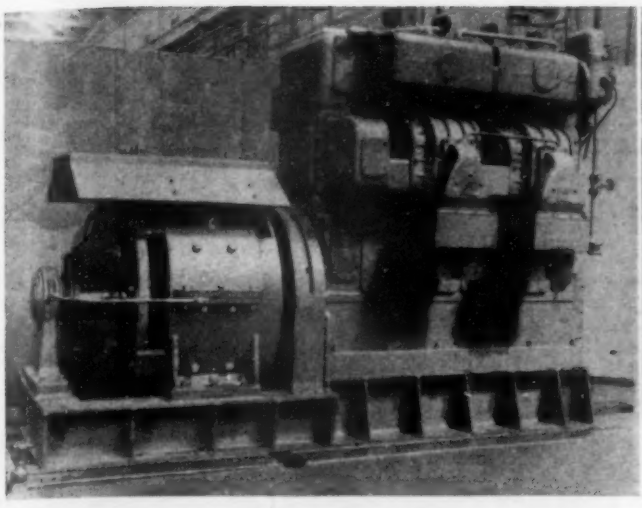

Fig. 7—Completed Engine and Installation

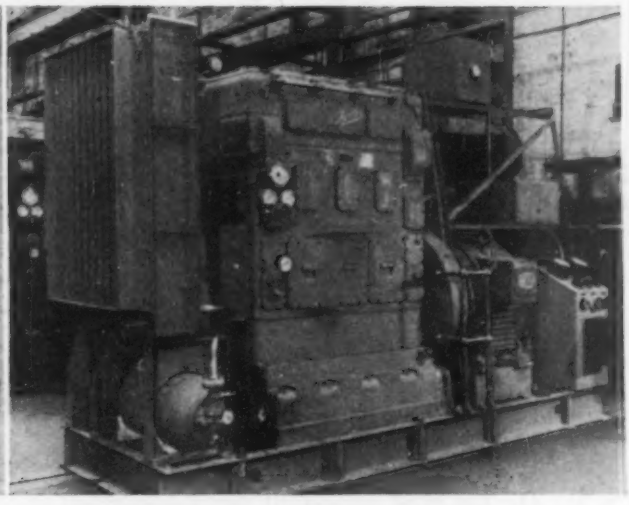

Fig. 8—Completed Engine and Installation

ing and setting in the foundry require highly skilled labor now in short supply. Here, again, the restrictions on the design imposed in our particular case must be recalled. It has not yet been possible to design the engine, completely *ab initio*, as a fabricated structure. Possibly the weight and cost might be reduced to a certain amount, but in the author's opinion, for what it is worth, not much more than 10–15% at the very most. Unfortunately, actual figures of cost cannot be disclosed for competitive and commercial reasons, but it is obvious that if it was not commercial we should not be doing it.

Acknowledgment

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Testing Spot-Welds*

A WELL-KNOWN British firm manufacturing spot-welding machines has developed an ingenious device for the routine inspection of spot welds which, apart from its intrinsic value, may be found useful for other applications. When spot welds were subjected to X-ray examination, it was found that when a small crater appeared within the area of the spot, these proved to be the strongest welds when subsequently subjected to tests of destruction. Radiographic inspection is, however, costly, and since it was known that austenitic material changes its magnetic properties when subjected to heat treatment, just as it does when stressed by shearing, working or rolling, spot welds were examined magnetically. It was then discovered that the better the welds the greater the magnetic permeability of the spots, and this discovery led to the development of a simple form of magnetic detector cell, used in conjunction with permanent magnets. The cell consists of a shallow dish of transparent plastic material, the back of the dish being formed of a thin diaphragm which is usually opaque or white. The cell is sealed off and filled with light oil in which minute magnetic particles are suspended. When the detector is laid on steel sheet that has been spot welded and to which an external source of magnetism is applied, a pattern is formed on the diaphragm indicating the spots which have reached a sufficiently high temperature during the welding process to produce satisfactory results. It is claimed that this method of testing spot welds is not only quick and reliable, but that unskilled persons are soon able to become proficient in applying it.—*Shipbuilding and Shipping Record*, Vol. LXX, No. 15, 9th October, 1947, p. 407.

* Reprinted from January 1948 issue of *Transactions of the Institute of Marine Engineers*, London.

Manual Use of Hidden Arc Welding Reduces Welding Time on U68 Code Work by 42%

By Emmett A. Smith*

ONE OF the most important developments in recent years in the welding field is equipment for the manual use of hidden arc welding. Its versatility and flexibility as a production tool are being demonstrated by the M. W. Kellogg Company in Jersey City, N. J., in the manufacture of refinery equipment. Most of the work to which it is being applied is U68 and U69 code welding on high-tensile steels which must meet X-ray inspection standards. Welding times have been reduced by 42% and over, while production of some items has been increased by 172%.

In Kellogg's fabricating plant, manual hidden arc welding is being used to weld heads on refinery towers, inside as well as outside, for welding nozzles on towers, fabricating condenser bonnets, tubing and shells.

The equipment that has been put to these varied uses is seen in Fig. 1 welding the outside seam of 12-in. piping for refinery use. The unit is called the Manual Lincolnweld. It is a portable self-sufficient unit providing all the necessary welding current and auxiliary power, plus automatic wire feed mechanism and controls. The basic element of the unit is a standard 600-amp. welder which can be used for either regular manual welding or for manual hidden arc welding. Mounted on the welder is a compact unit containing the wire reel, feed mechanism, drive motor and voltage controls. A special cable to which is attached a cone-shaped welding gun completes the equipment.

* Development Engineer, The Lincoln Electric Co., Cleveland, Ohio.

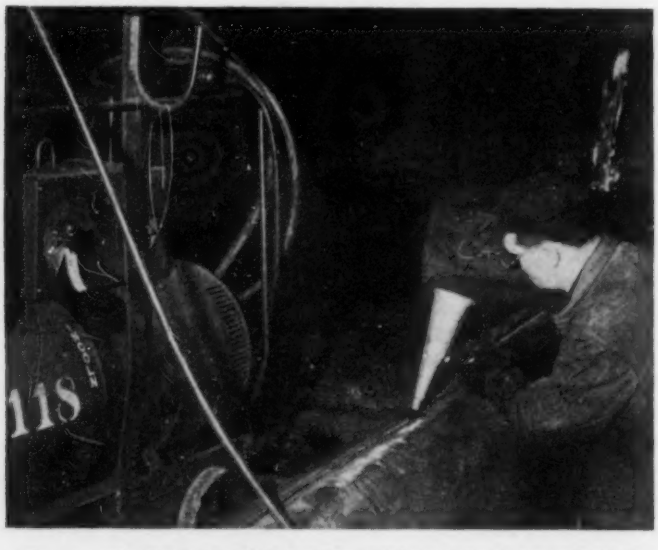


Fig. 1—The Portable Self-Sufficient Manual Lincolnweld Unit Permits the Use of the Hidden Arc Process of Welding in the Fabrication of Small Diameter Refinery Piping at the M. W. Kellogg Co. in Jersey City, N. J. Here the Welding Gun Is Guided by Hand to Make the Outside Weld. A Machine Setting of 400 Amp. with a Travel Speed of 18 In. per Minute Is Used. Welding Speeds on This Work Have Been Increased 100%. It Is All X-ray Work

Fig. 2—The Radiagraph Buggy in the Foreground Propels a Small Cart on Rails Through the Inside of the 12-In. Diam. Pipe to Make the Inside Seam

In manual hidden arc welding the electrode wire is fed automatically to the work through a granular flux that is deposited by gravity from the welding gun. The wire is fed from the reel and through the special cable to the gun at the proper speed for the amount of current being used. The cable is rubber-covered stranded copper, in the center of which is a closely wound coiled spring. The cable provides a light flexible carrier for both welding current and electrode wire. The process uses a small, $^{5}/_{64}$-in. diameter electrode to provide ease of operation in manipulating the gun.

A constant arc voltage is automatically maintained independently of the height of the gun above the work. The gun can, therefore, be raised or lowered to regulate the flow of flux needed to cover the arc completely. With the $^{5}/_{64}$-in. electrode wire extremely high-current densities are used. Because wire is fed through the gun nozzle at rates of generally around 300 in. per minute and because current is introduced to the wire close to the arc, it is possible to use 600 amp. with only a $^{5}/_{64}$-in. electrode. For regular hand welding an electrode over four times as

large, or $^3/_8$-in., is required to handle 600 amp. The current densities used with the manual hidden arc-welding equipment are higher than have ever been used before and effectively concentrate heat sufficient to weld $^3/_4$-in. plate in a plain butt joint, one pass each side, without edge preparation.

This simplified equipment for using hidden arc welding has extended the advantages of that process to applications where its use has previously not been economical or physically possible. The higher welding speeds and higher current densities used deposit at lower cost a deeply penetrating and smooth-appearing weld. The uniform heat application, slow rate of cooling and freedom from hydrogen in the weld metal facilitate welding in higher carbon and low-alloy high-tensile steels.

Figures 1, 2 and 3 illustrate the procedure for making piping for refinery use in 15-, 12- and 8-in. diameters. While at casual inspection the procedures may seem unnecessary, all of this work must pass X-ray examination and is rejected for the slightest flaw. All welds to be X-rayed are chipped and ground flush.

The tubing is rolled from plate in $^5/_8$-, $^1/_2$- and $^3/_8$-in. thicknesses. A sealer bead is first put on the outside of the seam in one pass with this unit. A radiagraph buggy is then set up with an extension, as shown in Fig. 2, for welding the seam on the inside. The welding gun is replaced with the setup, as shown in Fig. 3, to permit passage through smaller pipes. The first pass on the inside is made with a machine setting of 400 amp. at a speed of 18 in. per minute. For the second pass, in order to deposit a wider bead, the setting is cut down to 350 amp. at 14 inches per minute.

The track is then removed and the original sealer bead flame gouged with a torch to make a groove $^3/_{16}$-in. deep. This groove is seen in Fig. 1. The weld is then deposited on the outside with a setting of 400 amp. at a speed of 18 in. per minute. This is sometimes done in two passes, depending on the size of pipe and the amount of reinforce-

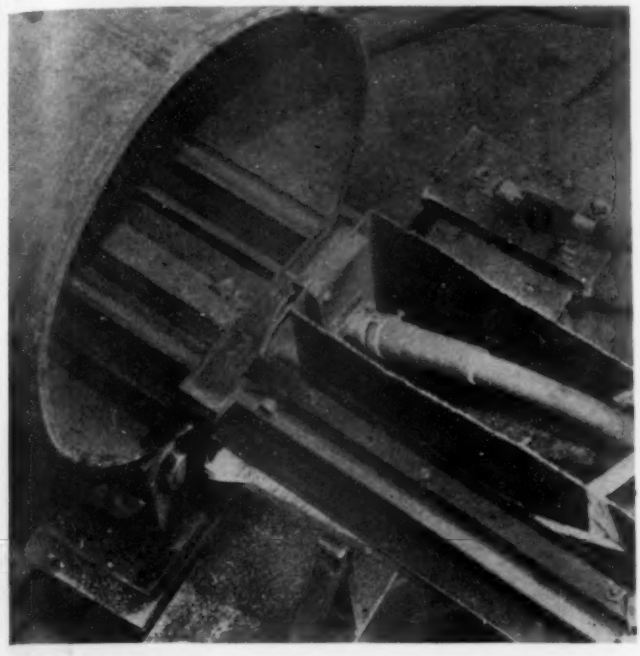


Fig. 3—The Conical Welding Gun Has Been Removed from the End of the Cable to Permit Passage Through the Pipe. The Flux Is Carried in and Deposited from the Box Mounted by the User in the Cart. A Portion of the Smooth Dense Weld Just Made Is Seen Between the Rails Going Through the Pipe

Fig. 4—Here the Equipment Is Used in Conjunction with a Variable Speed Positioner to Weld Flanges on Bonnets for Condenser Shells. The Increased Welding Speeds Have Stepped up Production from Two to Three and One-half Bonnets per Day

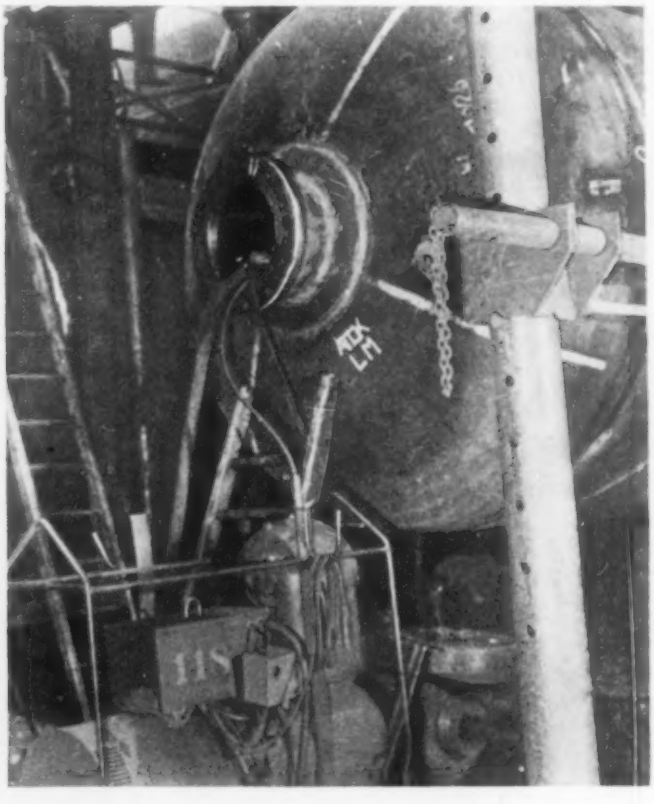


Fig. 5—The Welding Cable and Gun Have Been Taken Through the Manhole of This 9-Ft. Diam. Tower in Order to Make the Inside Joint Between the Head and Shell. For the First Time It Is Now Possible to Make Welds on the Insides of These Towers of the Same Quality as Are Made on the Outside with Fully Automatic Equipment

ment resulting. The weld is deposited with just enough reinforcement to permit grinding flush.

The hidden arc process as applied to welding this pipe increases welding speeds by 100% and produces smooth clean welds that require less chipping and grinding for X-ray.

In Fig. 4 the unit is being used to weld the flange to a bonnet for the top of a condenser shell. The thickness of the bonnet is $^5/_8$-in. First, a back-up bead is put in with a plain butt weld on the inside. The outside of the joint is then flame gouged to make a 37° groove. One pass is then put inside with a setting of 350 amp. and a speed of 14 in. per minute. The outside is welded with the machine set at 400 amp. using a travel speed of 14 in. per minute. The resulting bead is $^3/_4$ in. wide.

The production of bonnets has been increased by using the manual hidden arc welding from two per day to three and one-half per day.

The manual hidden arc welding has been particularly useful in eliminating porosity in the critical inside weld joining the head to the shell of catalytic towers. Whereas the outside welds are made with fully automatic equipment, there previously has been no alternative but to use hand welding on the inside since there is no way of getting the automatic unit inside after the head is on.

Figure 5 shows the Manual Lincolnweld equipment in use on the head of a tower 9 ft. in diameter and $1^{15}/_{64}$ in. thick. The welding cable and gun have been taken into the tower through the manhole to make the inside welds.

The head is first joined to the tower with a manually applied sealer bead that is made a new type, low hydrogen electrode to reduce probability of cracking. The outside weld is then completed with fully automatic equipment.

The inside of the joint is then flame gouged to prepare for welding. The groove gouged is $^5/_8$ in. deep and $^3/_4$ in. wide. Four passes are made using a setting of 400 amp. at a speed of 14 in. per minute (Fig. 6).

With manual hidden arc welding the inside weld is made on this tower at a considerable reduction in welding time over regular manual arc welding, and makes a deposit less critical in tendency toward porosity.

In addition to the applications illustrated, this new process has been used for making straight seams in $^1/_2$-in. plate that is then rolled into cones for penstock funnels.

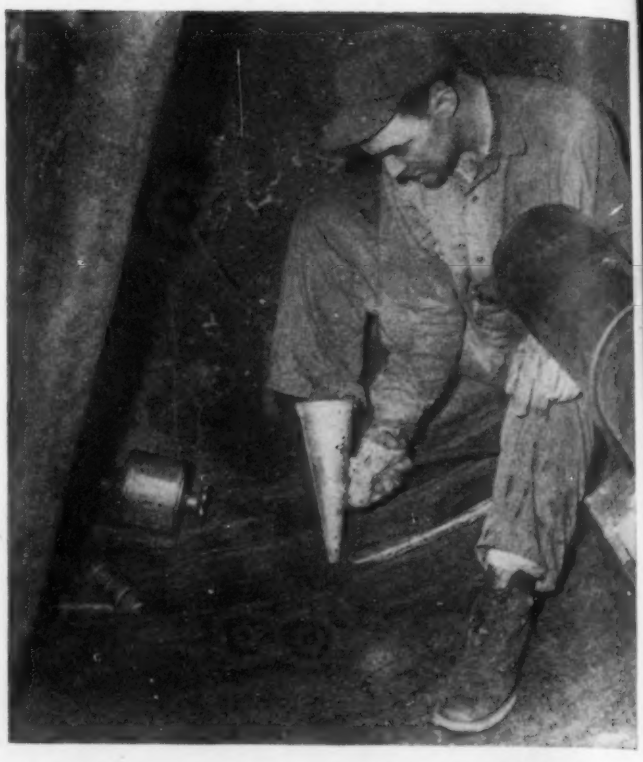
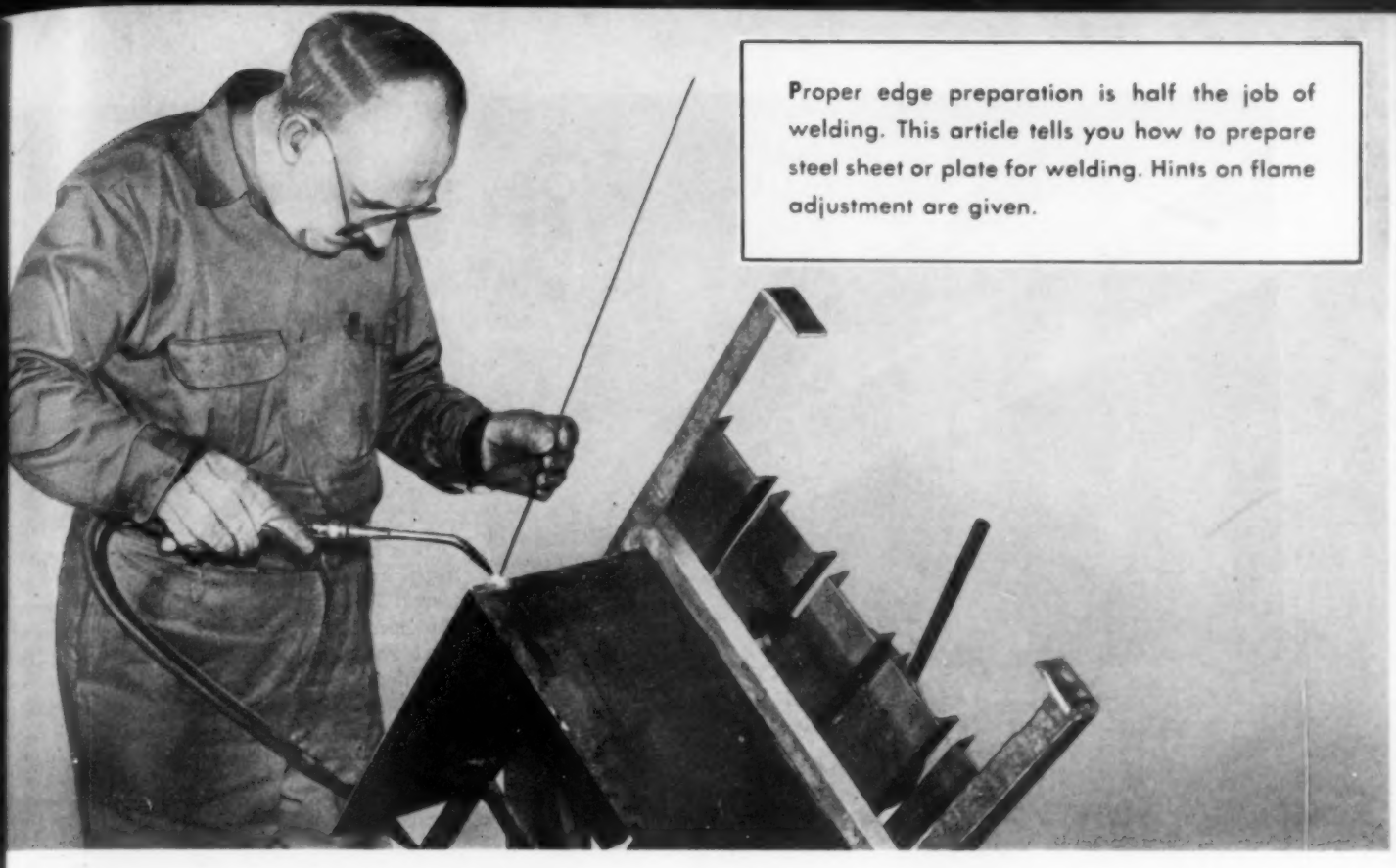


Fig. 6—Four Passes Are Made Inside the Tower in This Flame-Gouged Seam Joining the Head to the Shell. 400 Amp. at a Speed of 14 In. per Minute Are Used. The Absence of Smoke, Spatter and Visible Arc Rays Increase Operator Efficiency in Applications in Closed Quarters Such as This. Welds Deposited Are Dense and Free of Hydrogen Which Reduces the Tendency to Cracking and Eliminates Porosity. The Welds Must Pass X-ray Examination

It is used for welding flanges of all types and sizes. It has been useful as a repair tool for making repairs of high quality in fully automatic welds in which a flaw has been revealed. The manual hidden arc weld has not only reduced labor costs while improving quality on this critical work, but has taken much of the production off the already overcrowded fully automatic machines.



Proper edge preparation is half the job of welding. This article tells you how to prepare steel sheet or plate for welding. Hints on flame adjustment are given.

Getting Ready to Weld

By H. B. Gilson*

WHEN pieces are to be joined by welding, the kind and thickness of material and the method of fitting the pieces together determine the type of joint that will be used. Naturally, the preparation for welding includes any steps that are necessary to provide the best possible conditions, such as cleaning the metal edges, making allowances for expansion and contraction, and lining up the adjoining pieces.

Joint Design Depends on Thickness

Metals are classed as sheet or plate, according to their thickness. When material is $^1/_8$ in. or less in thickness it is called sheet and its thickness is specified by a gage number. There are several systems for gaging sheet and wire. In most all of the systems though, 16 gage designates material that is about $^1/_{16}$ in. in thickness and 11 gage, material that is $^1/_8$ in. in thickness. The thickness of plate materials ($^1/_8$ in. or more in thickness) is indicated by fractions of an inch, as $^5/_{16}$ or $^3/_8$ in. thick (see Fig. 1).

The main reason for welding is to join two pieces of metal into a single piece so that structurally there is no joint at all. To do this, the weld must completely penetrate the joint. Usually, metal must be added so that the thickness at the joint will be at least as great or slightly more than that of the materials being joined.

Methods for Welding Sheet

One type of joint, shown in Fig 2, is the flange joint. You can make this by turning up the edges, butting the pieces, securing them by tack welds, and then melting down the flanged edges. A sketch of the cross section is shown in Fig. 3. If the flanging has been done correctly, you will not have to add welding rod.

Where the design calls for the parts to be flanged and welded, flat sheets can be flanged by hand. The edge of the sheet should be turned up so that the height of the flange is equal to the thickness of the sheet. Put the piece in a vise and bend a flange by hammering, or clamp bar stock along the edges of the piece to hold it while the edge is flanged.

When making flat butt welds in steel sheet, you will not find it difficult to obtain complete penetration. Therefore, you can leave the edges of the sheet as they were when the pieces were trimmed to size. If the sheet has been sheared, there is usually a natural bevel due to the shearing action. Wherever it is possible, try to arrange it so that you can bring the edges together using this natural bevel to form a welding vee (see Fig. 4). Place the parts in position and hold them firmly by clamps or jigs while you make the tack welds. Space the parts about $^1/_{16}$ in. at the place where the weld is to start. The space at the finishing end should be $^3/_{16}$ or $^1/_8$ in. This allowance is necessary for contraction of the sheets during welding. Figure 5 shows the original edges and the weld

* The Linde Air Products Co., Newark, N. J.

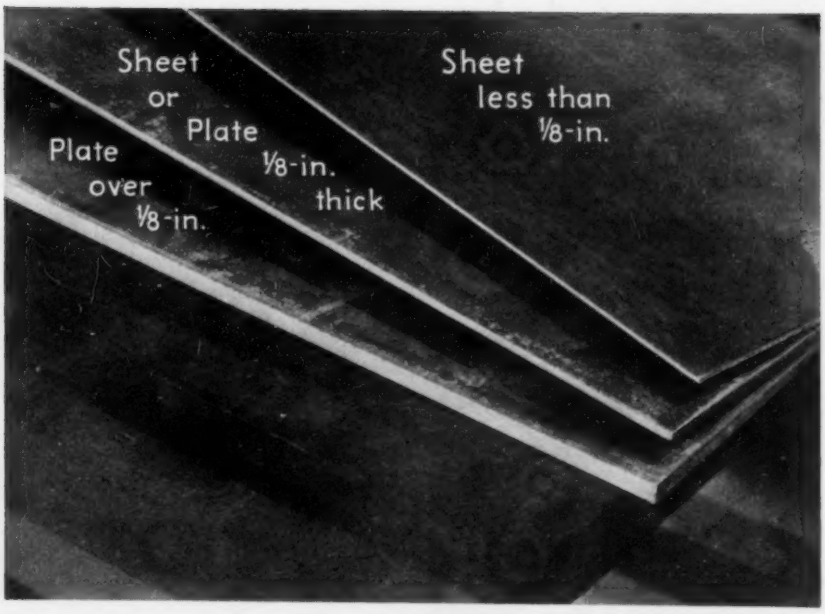


Fig. 1—Material Less Than $^1/_8$ In. Thick Is Called Sheet. Material Over $^1/_8$ In. Thick Is Called Plate

contour typical in joining sheet steel. Here necessary metal is added from a welding rod.

Methods for Welding Plate

You can make square butt joints in plate up to $^3/_{16}$ in. thick without beveling the edges. Since you will have to carry the puddle right to the bottom of the joint to obtain complete fusion, it will take more time and attention on your part to do this with $^3/_{16}$-in. plate than with thinner material. Beveling of material $^3/_{16}$ in. or more in thickness will pay for itself in better results and time saved. Figure 6 shows the weld contour and the original spacing of unbeveled plate.

The bevels can be made with an oxygen cutting blowpipe if you have one, or by grinding, chipping or machining. The angle between the beveled surfaces should be between 50 and 90° (see Fig. 7), depending on the welding technique to be used. For backhand welding, a narrower vee can be used. The angles are usually between 50 and 70°. The forehand technique requires a wider angle, usually between 70 and 90°, to allow room to swing the flame past the end of the weld and heat the sides of the vee ahead of the puddle.

Material that is beveled to a feather edge is satisfactory when reasonable care is taken to prevent the edges from melt-

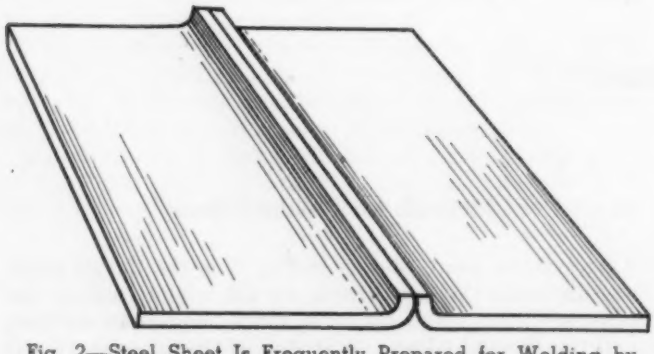


Fig. 2—Steel Sheet Is Frequently Prepared for Welding by Turning Up the Edges or Flanging

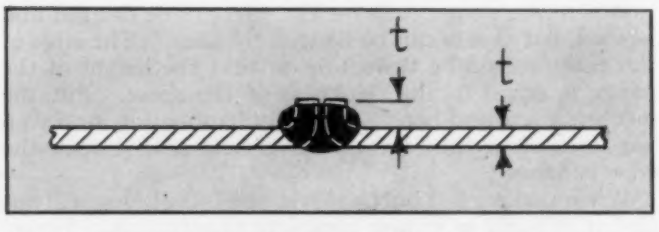


Fig. 3—The Height of the Flange Should Be Equal to the Thickness of the Sheet. Note the Outline of the Resulting Weld

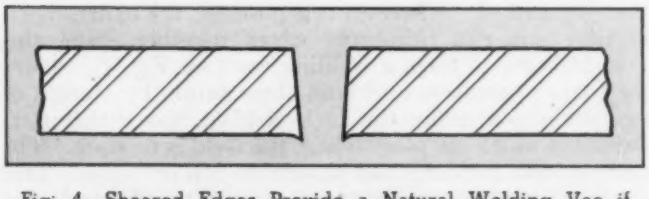


Fig. 4—Sheared Edges Provide a Natural Welding Vee if They Are Placed Together in the Right Way

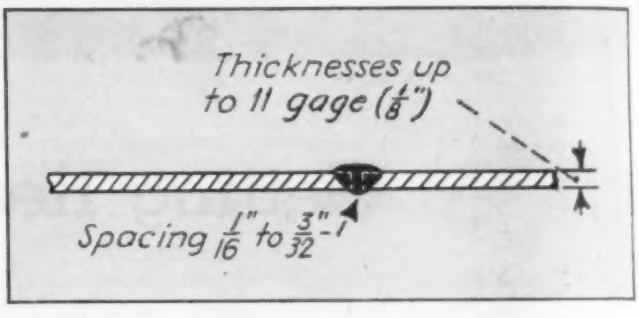


Fig. 5—When Welding Sheet with Square Edges, Leave a Space of About $^1/_{16}$ In. at the Start of the Weld. Note the Recommended Weld Contour

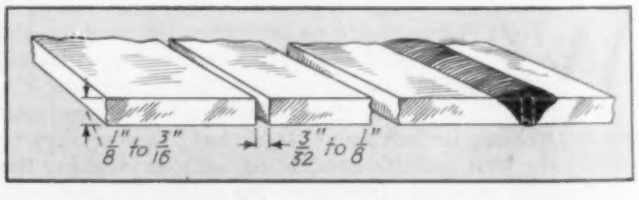


Fig. 6—You Can Weld Steel Plate from $^1/_8$ to $^1/_4$ In. Thick in One Pass Without Beveling. Space the Parts so That You Can Get Complete Penetration

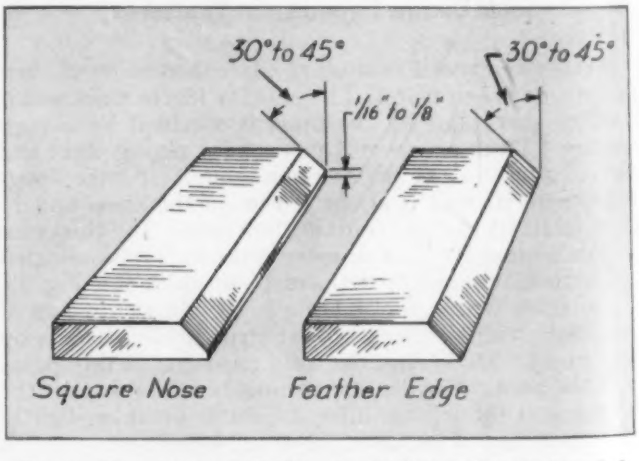


Fig. 7—Plate $^1/_4$ In. and More in Thickness Can Be Beveled with Either a Square Nose or a Feather Edge

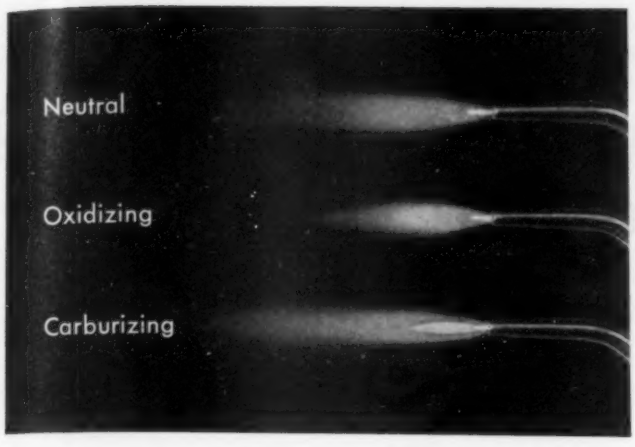


Fig. 8—There Are Three Common Types of Oxyacetylene Flames as Shown Above

ing too much and allowing the puddle to drop through. It is usually better, however, to prepare the pieces with a square nose of $^1/_{32}$ in. or more. The parts of the assembly should be spaced and secured by tack welds before proceeding with the welding. Leave a $^1/_8$-in. space at the starting end of the weld and $^3/_{16}$ to $^1/_4$ in. per ft. at the finishing end of the weld. This is to allow for contraction during cooling of the weld metal.

Flame Adjustment

The neutral flame is required for welding wrought iron and the plain, low-carbon steels. To adjust the blowpipe for a neutral flame, you must recognize the three types of flames and the adjustments required to produce them.

The flame will probably be orange-colored when first lighted. Turn on more oxygen until the flame burns with a clear white light. Then close the acetylene valve slowly. Notice that the blue-white "feather" decreases and the "inner cone" becomes more pronounced. The feather indicates an excess acetylene flame. As you close the acetylene valve further, the feather will get shorter and finally disappear into the inner cone. This is the neutral flame. If you shut off the acetylene further, the cone will become slightly smaller, more sharply pointed, and slightly purplish in color. This is the oxidizing flame. The three types of flame are shown in Fig. 8. To increase the length of the flame, first add acetylene, then oxygen and then readjust. To decrease the length of the flame, turn down the oxygen and then adjust the acetylene to obtain the proper type of flame.

When you use gas pressures higher than those recommended for the particular tip, a harsh flame is produced. The harsh flame depresses the puddle surface considerably and causes the molten metal to splash and spatter around the edges of the puddle. With this type of flame, you will have trouble controlling the molten weld metal. When the gas pressures are correct, a soft flame will be produced. The soft flame does not depress the puddle so much and the puddle remains quiet so that you have complete control at all times. A soft neutral flame is the best one to use in fusion welding of mild steel.

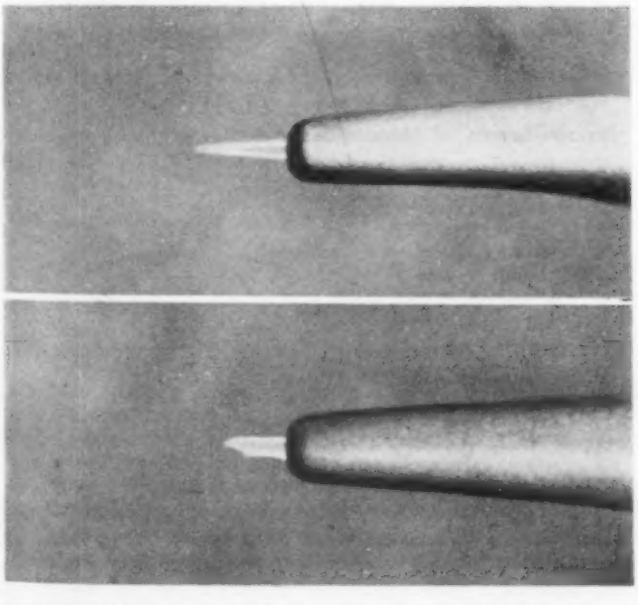


Fig. 9—The Neutral Flame Made by a Clean Tip Is Regular in Shape (Above). A Dirty Tip (Below) Makes an Irregular Flame

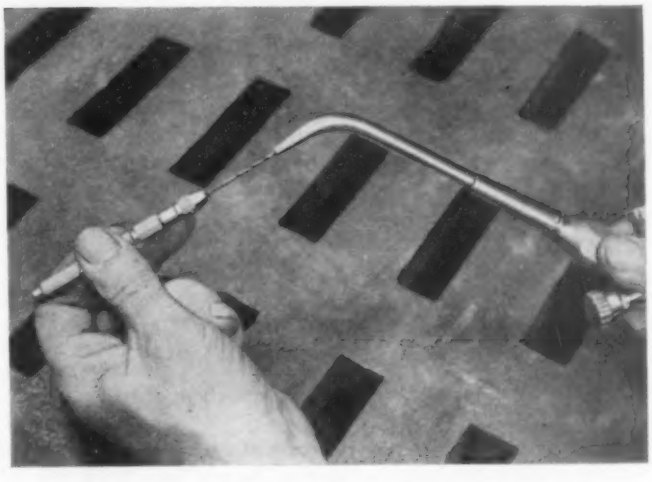


Fig. 10—This Is the Proper Way to Clean a Blowpipe Tip

The blowpipe tip must be clean to produce a proper flame. The flame produced by a clean tip is regular in shape, easily adjusted and provides an excellent source of heat for welding. The flame produced by a dirty tip is irregular in shape, provides an uneven source of heat, is difficult to control, and may pop out while you are attempting to adjust it or work with it. Compare the two flames in Fig. 9. The uneven flame is caused by dirt in or near the opening of the tip. Such dirt is usually slag or oxide which clogs the tip when you accidentally touch it to the work. Cleaning the tip by hand with a proper-size drill or tool, as shown in Fig. 10, will remedy the situation. Be careful not to enlarge or "bellmouth" the opening. Once the tip has been damaged, it will not produce a properly shaped flame.

Penetration and Travel Speed in Metal Arc Welding*

By R. Gunnert

THE following formula for penetration in Unionmelt welding was published in the April 1947 issue of *Svetsen*.

$$P = G \sqrt[3]{\frac{I^4}{VE^2}}$$

where

P = penetration, measured as shown in Fig. 1
I = current
E = voltage
V = travel speed, cm./min.
G = a constant depending on the flux and the type of current.

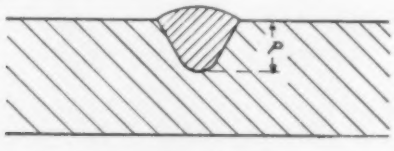


Fig. 1—Definition of Penetration, P

To determine whether this formula was valid for manual welding with coated electrodes, beads were run by an expert operator on $^1/_2$-in. plates of mild steel, Fig. 2. The plates were 12 x 20 in. and each plate was allowed to cool to room temperature before depositing a bead. Each plate was cut at three sections and polished and etched for measurement of penetration with a microscope.

The tests were made with three electrodes. The first was AGA-EK-44, a neutral type of mineral-coated electrode with a tensile strength of about 63,000 psi. It is used on straight polarity, particularly for horizontal fillets. Electrode AGA-EU-46 has a thick basic coating and is used on reverse polarity. The extra heavily coated OK Rapid electrode is intended for fast fillet welding with deep penetration.

* Abstract of "Sambandet mellan stränghastighet och inträngning vid metallbågsvetsning," published in *Svetsen*, Vol. 7, No. 2, 33–35, March 1948. (Abstracted by G. E. Claussen.)

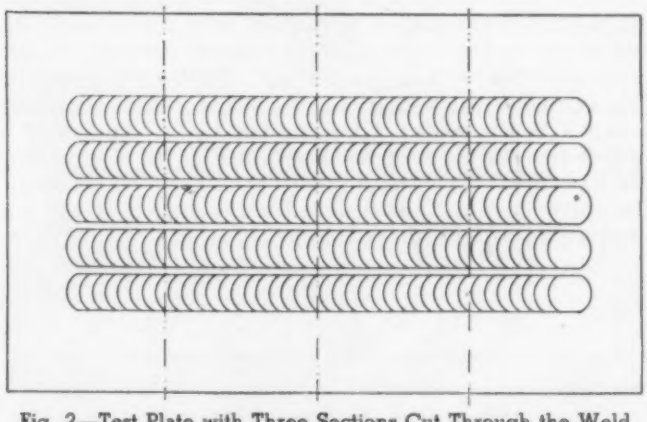


Fig. 2—Test Plate with Three Sections Cut Through the Weld Beads

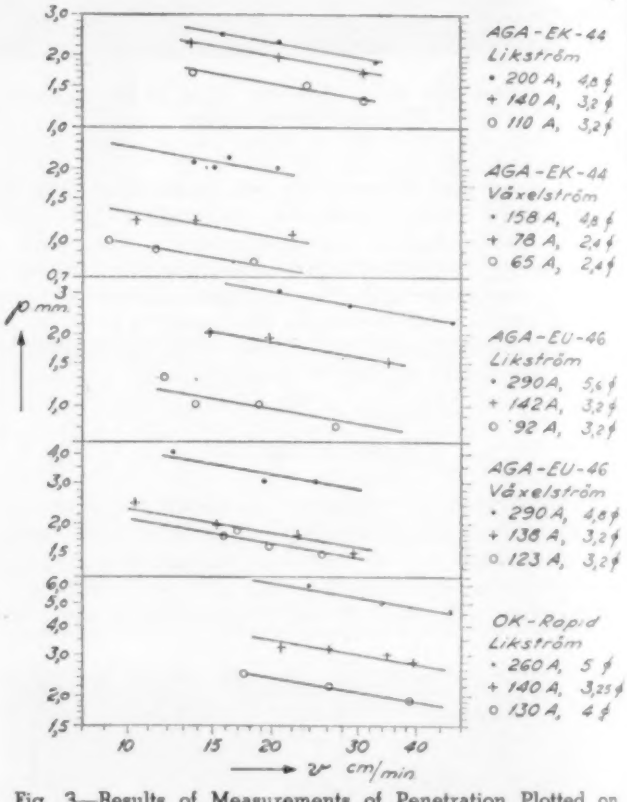


Fig. 3—Results of Measurements of Penetration Plotted on Logarithmic Coordinates

The lines drawn through the points fit the equation in the text.
V = travel speed, cm./min.
P = penetratiön, mm.
ϕ = diameter of electrode, mm.
Likström = direct current
Växelström = alternating current

The results plotted in Fig. 3 on logarithmic coordinates follow an equation of the type:

$$P = \frac{G_\phi}{\sqrt[3]{V}}$$

where G_ϕ is a constant which is different for each diameter of electrode, for each type of current, amperage, voltage and flux. A comparison may be made between the manual welding results and the formula for Unionmelt welding. For example, AGA-EU-46 on AC, I = 290 amp., V = 25 cm./min., and $^3/_{16}$-in. electrode had a penetration of 3.30 mm. Using the Unionmelt formula and constant:

$$P = 0.039 \sqrt[3]{\frac{(290)^4}{25 \times (35)^2}} = 2.4 \text{ mm.}$$

It is obvious that penetration in manual welding is as great as or greater than with Unionmelt welding if the comparison is made at the same levels of current, voltage and speed.

THE AMERICAN WELDING SOCIETY

ACTIVITIES—RELATED EVENTS

NOMINEE FOR VICE-PRESIDENT, DISTRICT NO. 6

Ray L. Townsend, born in Wichita, Kan., on June 26, 1912, acquired schooling in Wichita Public Schools, graduating from Wichita High School East in 1929, majoring in commercial work. His early business experience was with machinery and equipment firms who specialized in welding. He covered the State of Kansas for ten years for one firm in a selling capacity devoting almost entire time to the sales promotion and demonstration of various welding processes.

Ray L. Townsend

Mr. Townsend is a Charter member and one of the founders of the Wichita Section of the AMERICAN WELDING SOCIETY. He served in practically all offices of the local Section and was Chairman in 1945.

In 1937 he founded Tweco Products Co., at which time his developments were placed on the market on a national basis. The Company manufactures a complete line of cable connections and tools for electric welding which are today marketed all over the world through welding supply distributors. Today, Mr. Townsend is Partner and General Manager of Tweco Products Co. He is an ardent believer in the future of welding and devotes almost his entire time to its promotion either, through his own company, the A.W.S. or the National Welding Supply Association of which he is also a member. Mr. Townsend likes to travel, play golf and fish. He is a member of the Kiwanis Club.

CORRECTION

With reference to the "Nomination of Officers and Directors" and their write-ups in the June issue of THE WELDING JOURNAL, the write-up of Howard N. Simms' is listed incorrectly under "Vice-President District No. 6." Mr. Simms was nominated as a Director at Large..

SYMBOLS WALL CHART

The SOCIETY has published a 22 x 30-in. wall chart summarizing the Standard Welding Symbols in order to make it available to all industrial organizations and educational institutions for use in their drafting rooms and shops.

All who have seen the latest issue of the Standard Welding Symbols will realize that this handy wall chart is actually an enlargement of the summary chart contained in this booklet. The chart gives the basic welding symbols, location of elements of a welding symbol, typical welding symblols, supplementary symbols, and shows how to identify the "arrow" side and "other" side of a joint.

Copies of this chart are available from AMERICAN WELDING SOCIETY Headquarters at 33 West 39 St., New York 18, priced at fifty cents per copy. The usual discount will be given to members.

SCIENTIFIC AND TECHNICAL ABBREVIATIONS SIGNS AND SYMBOLS

Scientific and Technical Abbreviations Signs and Symbols, by O. T. Zimmerman and Irvin Lavine. Published by Industrial Research Service, Dover, N. H. Price $7.50. Here is the time-saving book that has long been needed by all scientific and technical workers. In a single volume, the authors have brought together thousands of abbreviations, signs and symbols of scientific and technical terms in numerous fields, and thousands of important graphical symbols used in preparing drawings, charts and maps.

Here you will find—grouped into various fields for maximum utility—the important abbreviations, signs and symbols used in engineering, mathematics, chemistry, thermodynamics, aeronautics, radio, electronics, hydrography, topography, meteorology, astronomy, zoology, botany, medicine, communications, commerce and banking, machine and tool shops and numerous others.

DR. SACHS GOES TO INDIA

Dr. George Sachs, Director, Research Laboratory for Mechanical Metallurgy and Professor of Physical Metallurgy, Case Institute of Technology, Cleveland, Ohio, has been appointed Director, National Metallurgical Laboratory, Jamshedpur, India. He will assume his new duties on Oct. 1, 1948.

The National Metallurgical Laboratory is one of five new governmental research laboratories recently established by the Indian Council for Research and Development, the others being the National Chemical Laboratory, the National Physical Laboratory, a Fuel Research Station, and a Central Glass and Ceramics Research Institute.

The N. M. L. will cover all aspects of metallurgical research, both fundamental and applied, and will also carry out research work on ores, minerals and refractories. Close cooperation with the modern research laboratory of the nearby Tata Iron and Steel Company will be established. Special consideration will also be given to research on nonferrous metals such as copper, aluminum, manganese, zinc, titanium and beryllium, of which India has abundant ores, and for the production of which large power resources are available. In the initial stages of the work of the laboratory, the special and urgent needs of India will require particular attention to applied rather than fundamental research. The N. M. L., therefore, includes a well-equipped Technological Section which will permit establishing and operating pilot plants. On long-term research of a fundamental nature, the various National Research Laboratories will work in close cooperation.

It is planned at present to provide 35,000,200 sq. ft. of laboratories. Amplespace is also available for future extension. The main building will have a front of 480 ft. Detailed information may be secured from a pamphlet, "Revised Scheme for the Establishment of the National Metallurgical Laboratory," published by the Council of Scientific and Industrial Research, Delhi, 1946.

Dr. Sachs has been a member of the Case faculty since 1939. Before joining Case he was directing research and teaching in Germany, and has held several executive industrial positions in Germany and the United States.

Dr. Sachs is the author of numerous papers in scientific and technical journals, and of a number of books, among them *Practical Metallurgy* and *Forming of Austenitic Chromium-Nickel Alloys*.

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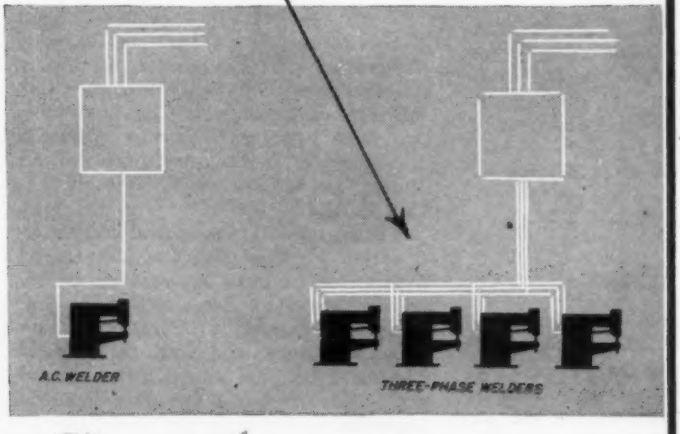

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A.S.M. NOMINEES

Dr. Harold K. Work, manager of research and development of the Jones and Laughlin Steel Corp., Pittsburgh, has been nominated for the office of president of the American Society for Metals by a committee of the 21,000 members of that international body. Four other of the nation's prominent metallurgists have been nominated for the posts of vice-president, secretary and two trustees. All nominations are for 1948–1949.

W. H. Eisenman, national secretary of A.S.M., made the announcement from the Society's national headquarters in Cleveland. Mr. Eisenman explained that nomination is tantamount to election when the Society convention meets in Philadelphia this fall during the National Metal Congress and Exposition, October 23–29.

Dr. Work now holds the office of A.S.M. national vice-president and previously was its treasurer.

Dr. Arthur E. Focke, research metallurgist of the Diamond Chain and Manufacturing Co., Indianapolis, Ind., was nominated for vice-president of the Society. W. H. Eisenman, present secretary, was nominated for his 16th consecutive two-year term in that office, having first been elected in 1918. Dr. Harry Croft, Director of Technical Control and Research, Chase Brass and Copper Co., Cleveland, Ohio, and Frederick J. Robbins, manager, Sierra Drawn Steel Corp., Los Angeles, Calif., were nominated for two-year terms as national trustees of the A.S.M.

When elected, Dr. Work will succeed Francis B. Foley of Philadelphia, Midvale Corporation executive.

1947 SUPPLEMENT TO BOOK OF A.S.T.M. STANDARDS

To keep up to date the triennially published Book of A.S.T.M. Standards, the American Society for Testing Materials in the intervening year issues Supplements to each part of the book. The 1947 Supplements recently issued in five parts, give in their latest approved form, some 330 specifications, tests and defintions which were either issued for the first time in 1947 or revised since their appearance in the 1946 Book.

Part I-A on Metals, 350 pages, includes 70 standards covering ferrous metals and materials, including steel, wrought iron, cast iron, etc. There are 13 boiler steel plate specifications; nine on structural steel, bar steels, etc.; 15 for spring wire, forgings, axles and the like. A large group covers pipes and tubes; there are three on steel castings; and nine relate to stainless steel, magnetic properties and metallic coatings. There are others on cast and malleable iron; general testing, etc.

Part I-B on Nonferrous Metals. This part covering 334 pages has some 70 standards including two on ingot and cathode copper; four on copper and copper-alloy wire for electrical conductors and two on copper-alloy castings. There are 45 on copper and copper-alloy products—plate, tubes, strip, etc.; six on aluminum and aluminum-base alloys; five on magnesium and magnesium-base alloys; two on electrical-heating, resistance and related alloys; one on metal powders and products; and several on general testing methods.

Other parts cover nonmetallic materials.

Copies of these 1947 Supplements can be obtained from A.S.T.M. Headquarters, 1916 Race St. Philadelphia 3, Pa., at $4.00 per part, all five parts, $20.00. Each is bound in heavy paper cover. The five 1947 Supplements, plus the 1946 Book of Standards, give a complete set of all A.S.T.M. specifications and tests, excepting those on chemical analysis of metals which are in a special volume.

CATALOG SHEET ON NU-ARC

An informative catalog sheet containing complete specifications and data on a recent development in welding equipment in the form of the NU-ARC General Purpose a.-c. Arc Welder has been prepared and is now available on request from the manufacturer, Electric Arc, Inc., 152–162 Jelliff Ave., Newark 8, N. J.

The NU-ARC is an innovation in welding machine design since all moving parts have been eliminated to increase operating efficiency. This fact is of particular interest to welding shops, industrial plants, shipyards, railroads and other fields where welding is a part of production.

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The man we are looking for is the one outstanding engineer in the United States who best combines these two requirements:

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We also have a place in our organization for a capable and experienced "Applications Engineer" familiar with the application of resistance welding processes and equipment to all kinds of production problems.

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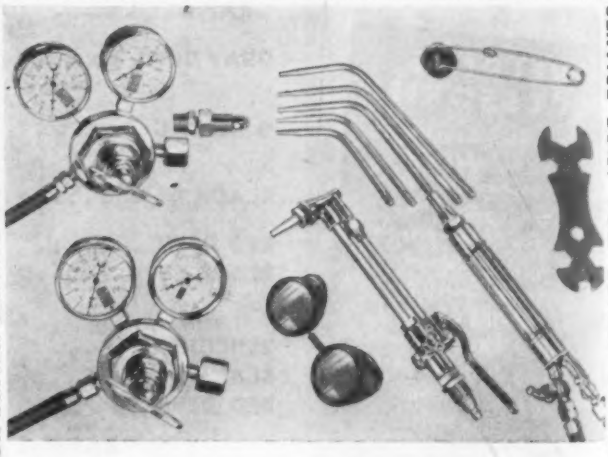

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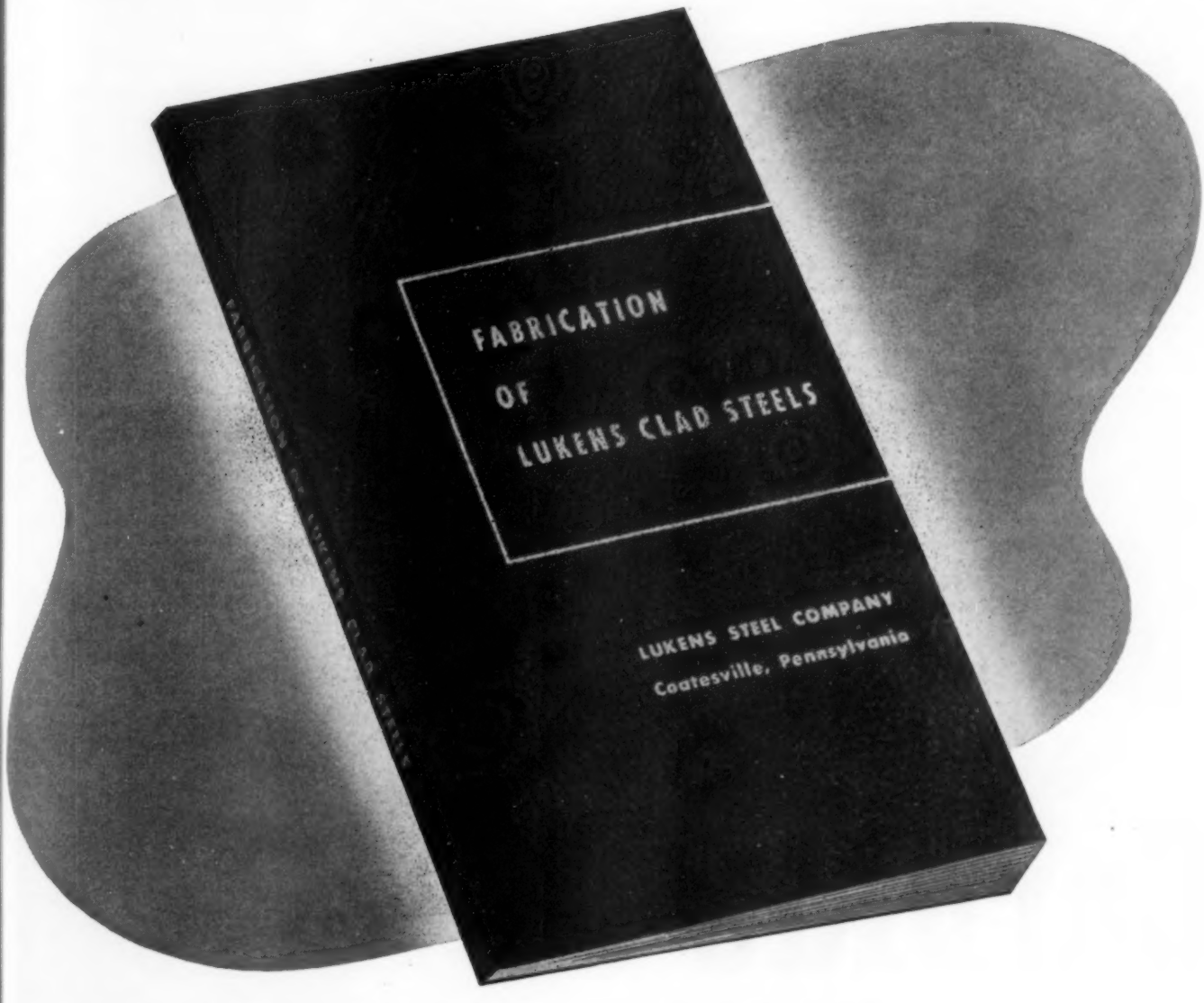

How to fabricate Lukens Clad Steels is told in this brand-new, 100-page book; Nickel-Clad, Stainless-Clad, Inconel-Clad and Monel-Clad. *How* to handle, cut, form, weld and finish—

Welders will find recommended procedures for each step described here in detail. Follow them and you'll gain full *clad* steel economy with the protection of the *solid* corrosion-resistant metal protection.

The types of cladding available through Lukens are listed—the widest range available from any source. Their physical and chemical properties, together with specific suggestions for their application, are shown.

You may have a copy of this new book. Just write Lukens Steel Company, 407 Lukens Bldg., Coatesville, Pa.

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STEELS

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NATIONAL WELDING SUPPLY ASSOCIATION

The Fourth Annual Convention of the National Welding Supply Association was held on May 20th and 21st at the Sheraton-Coronado Hotel, St. Louis, Mo.

An Exhibit by Manufacturer Members was held in the El Cortez Lounge during the Convention. Sixteen companies were represented in this Exhibit.

The Convention was called to order on Thursday, May 20th, by Ralph E. Chase, President of the National Welding Supply Assoc. Following introductions and reports on activities and membership of the Association, three papers were presented by representatives of the Westinghouse Electric Corp., The Linde Air Products Co. and the W. P. & R. S. Mars Co. of Duluth, Minn.

Four papers were presented at the Distributors' Session in the afternoon, by representatives of the Purity Cylinder Gases, Inc., Compressed Gases of Ohio, Inc., R. S. McCracken & Sons, Inc., and James C. Dawes Co.

A number of discussions took place at the Manufacturers' Session also held on Thursday afternoon.

On Friday morning, following the opening remarks, J. G. Magrath, Executive Secretary of the AMERICAN WELDING SOCIETY, spoke on "The American Welding Society—Its Purposes and Objectives." This was followed by three talks by representatives of *Industry and Welding*, Machinery & Welder Corp. and Miller Electric Manufacturing Co.

Four papers were presented at the Friday afternoon session by representatives of Henry's Welding Supplies, Red Arrow Sales Corp., Tweco Products Co. and O. K. I. Welding Supply Co.

TECHNICAL SOCIETIES COUNCIL OF NEW YORK ELECTS OFFICERS

The Technical Societies Council of New York held its annual meeting and election of officers on Thursday, May 20th, at the Engineering Societies Building, 29 W. 39th St. The Council was incorporated just a year ago, with local groups of 14 leading engineering societies, representing some 25,000 engineers in the metropolitan area, as charter members. Each society has two delegates to the Council, which serves as a medium for mutual professional betterment, more effective public service, the furtherance of high professional standards and the advancement of engineering and scientific knowledge. Officers elected were:

President—C. S. Purnell of the American Institute of Electrical Engineers, in charge of the petroleum section Industry Dept., Westinghouse Electric Corp., 40 Wall St.

Vice-President—O. B. J. Fraser of the American Institute of Mining and Metallurgical Engineers, assistant manager of the Development and Research Div., International Nickel Co., 67 Wall St.

Secretary—Dr. W. F. O'Connor of the American Chemical Society, associate professor of chemistry at Fordham University.

Treasurer—Professor M. C. Giannini of the American Society of Heating and Ventilating Engineers, associate professor of air conditioning at New York University.

The Council also elected five new directors. The officers of the council and its directors, six in number, constitute its governing board.

ELEMENTARY PHYSICAL METALLURGY

Elementary Physical Metallurgy with Emphasis on Ferrous Metallurgy, by Edward G. Mahin, Ph.D., Professor of Metallurgy and Head of the Department of Metallurgy, University of Notre Dame, 1948. Remsen Press Division, Chemical Publishing Co., Inc., Brooklyn, N. Y. 290 pages. $6.00.

It is a well-recognized fact that the principles which are fundamental to the physical metallurgy of the iron-carbon alloys are fundamental also to all physical metallurgy, whether ferrous or nonferrous. Even though the treatment of the subject in these pages does lean rather heavily toward the ferrous side of the subject, it is the hope of the author that the book will prove to have a certain value to those whose interests, whether as students or as plant workers, are in nonferrous fields. With the idea of maintaining a truly elementary character of treatment, citations to the metallurgical literature have intentionally been omitted.

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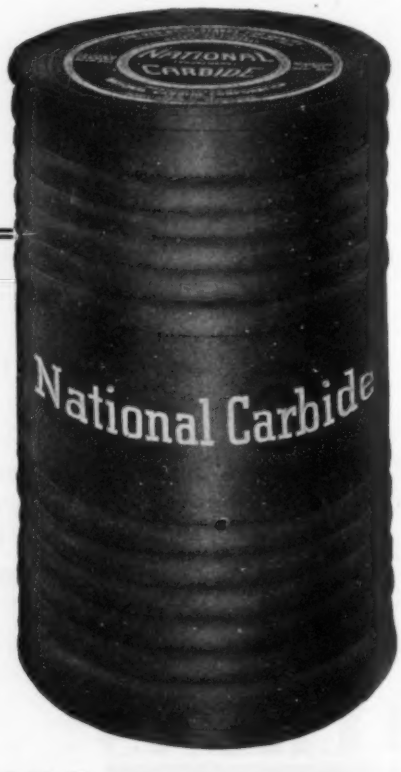

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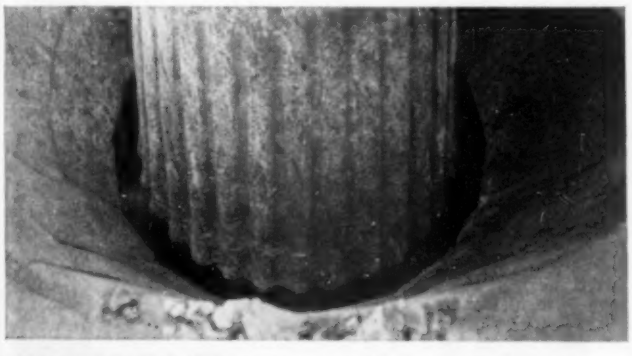
Suggestions on Hard Facing

TO RESIST EXTREME ABRASION, long wearing surfaces made of tungsten carbide particles having self-sharpening qualities are now easily deposited with the new **"Tungweld"** electrodes. Fine particles of tungsten carbide (**"Tungweld F"**) are used for cutters and knives where smooth, keen edges are required such as the post hole auger shown. Coarse particles of tungsten carbide, produced with **"Tungweld C"**, are for hardfacing heavy equipment such as earth moving machinery.



FOR SEVERE ABRASION AND MODERATE IMPACT, heavy equipment, such as this rock crusher, is quickly reclaimed with **"Faceweld"** electrodes. Suitable for hardsurfacing carbon and manganese steels, **"Faceweld"** deposits have a hardness of 40 to 60 Rockwell C and corrosion resistance equal to stainless steel.

TO INCREASE TOOL LIFE, cutters and dies are speedily hardsurfaced with **"Toolweld".** The weld metal is equivalent to high speed steel and has a hardness of 60 to 65 Rockwell C. After hardsurfacing with **"Toolweld"** this die turns out an additional 40,000 parts.

TO BUILD UP MANGANESE STEEL, weld beads equivalent to cast manganese (5 to 10 Rockwell C) are produced with **"Manganweld".** Cold working increases the hardness to Rockwell 45 to 50 C, making **"Manganweld"** ideal for heavy equipment resisting abrasion and impact, like the rock crusher shown.

FOR SELF-HARDENING DEPOSITS, resistant to severe abrasion, pronounced battering and impact, **"Abrasoweld"** is recommended. An "as welded" hardness of 20 to 40 Rockwell C is increased by peening to over 50 Rockwell. Hardfaced with **"Abrasoweld"** this power shovel dipper tooth is typical of equipment reclaimed with this electrode.

FOR SHOCK AND ABRASION on heavy slow moving machinery, **"Hardweld"** deposits a hardfacing of 20 to 45 Rockwell C hardness. The power shovel drive sprocket is faced with **"Hardweld"** to increase service life four times.

The above is published by LINCOLN ELECTRIC in the interests of progress. Handy pocket-size "Welding Guide" free on request. Write The Lincoln Electric Company, Dept. 107, Cleveland 1, Ohio.

Advertisement

MORTON-GREGORY CORP., NEW DETROIT-TOLEDO FIRM, ACQUIRES NELSON STUD-WELDING BUSINESS

Purchase of the manufacturing assets and patent interests of the Nelson Stud Welding Corp. of Lorain, Ohio, and its associated companies, developers and leaders in the stud-welding field, by the recently formed Morton-Gregory Corp. of Michigan was announced recently by Henry J. Morton of Detroit, president, and George E. Gregory, Toledo, vice-president and general manager of the new firm.

Acquisition of the stud-welding business by Morton-Gregory, which has established executive and sales offices in the Manhattan Building, Toledo, broadens its established activities in the electrical specialty field to embrace construction, railroad, automotive, shipbuilding and other metal-using industries in which the range of stud-welding applications is rapidly expanding.

Purchase of the Nelson Stud Welding interests from Ted Nelson, the 40-year-old inventor who developed stud welding eight years ago while working as an eleven-dollar-a-day welder in the Mare Island Navy Yard, marks a climax in one of the most picturesque industrial sagas of the war period. Starting from scratch in his own garage with the development of revolutionary flux-filled studs and an automatic welding gun by which they could be end-welded to ship plate and other metal surfaces, Nelson soon had engineers and production men from shipyards up and down the West Coast beating a path to his door.

After winning three Army-Navy E's for production of the "guns" and studs in his original plant at San Leandro, Calif., Nelson established a second modern plant at Lorain, Ohio, in 1945, to serve the expanding peacetime market for studs required by car builders, appliance manufacturers, automotive factories and many branches of the construction industry. The same time-saving, cost-cutting advantages which had led wartime shipbuilders to adopt stud welding for the installation of decking, insulation, conduit, and many other jobs were soon being interpreted to alert engineers and production executives throughout the country by field engineers operating out of Nelson's branch offices in 18 of the country's principal manufacturing centers. Manufacturers' license agreements were also granted in several foreign countries.

In announcing purchase of the stud-welding business, Mr. Gregory stated that all of the Nelson manufacturing and engineering activities will be centralized at the Lorain plant, which will be known as the Nelson Stud Welding Division of Morton-Gregory Corp. Nelson's present staff of field engineers and its 18 engineering offices will be continued as part of this Division.

The Morton Research Laboratories will continue operations in Detroit as a division of Morton-Gregory. Their program will include research directed toward the wider use of stud welding.

RESISTANCE WELDING BOOK

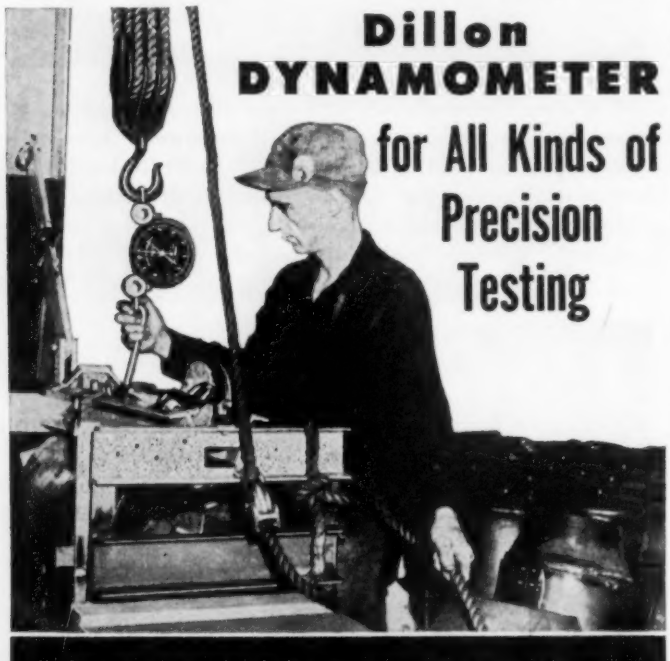
A very attractive resistance welding book written in French has just come to our attention. This book has 432 pages, is well illustrated and written in a popular style. The book is published by Publications de la Soudure Autogene, 39, Rue d'Amsterdam, Paris VIII, France. Price, 1350 francs.

NEW BOOK ON HIGH-TEMPERATURE ALLOYS

A new 87-page book, entitled "Haynes Alloys for High-Temperature Service," has just been published by Haynes Stellite Co., Kokomo, Ind. It contains all the available data on Haynes alloys that have been compiled by the National Defense Research Council, the National Advisory Committee for Aeronautics and prominent manufacturing concerns.

Engineers and metallurgists who design or specify equipment for high-temperature use will find this new book an invaluable aid in the selection of alloys to meet the exacting demands of such service. In addition to a general description of each Haynes alloy, there are tables giving chemical composition and physical properties. Mechanical properties are presented in both tabular and graphic form. Short-time tensile properties and stress-rupture properties of all the alloys are also compared in graphs.

Copies of the booklet may be obtained by writing to Haynes Stellite Co., Kokomo, Ind.



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Tests tensile strength of bomb racks, spot welded sections, bulky objects of every description. Used with air hoists, chain hoists, turn-buckles for load application. 9 different capacities from 0-500 lbs. up to 0-20,000 lbs. — all same size, same weight. Thousands in use by leading concerns and armed forces. Measures only 8¼" x 6¼" x 3"; weighs 8 lbs. 4 oz. Write today for technically illustrated catalog.

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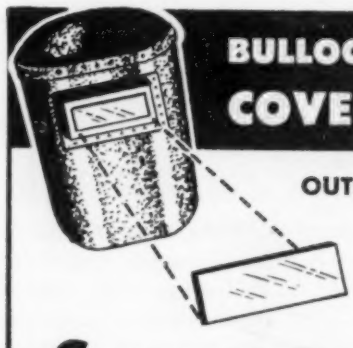

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Pin a dollar to the coupon and mail it right now. It will save you lots of dollars later. You'll find that Bullock Coated Cover Glasses last 10 to 20 times as long as ordinary cover glasses. Navy Yards and shipbuilders bought Bullock glasses by the millions during the war because they eliminated frequent changes and they produced better welding by improving vision and ending eyestrain.

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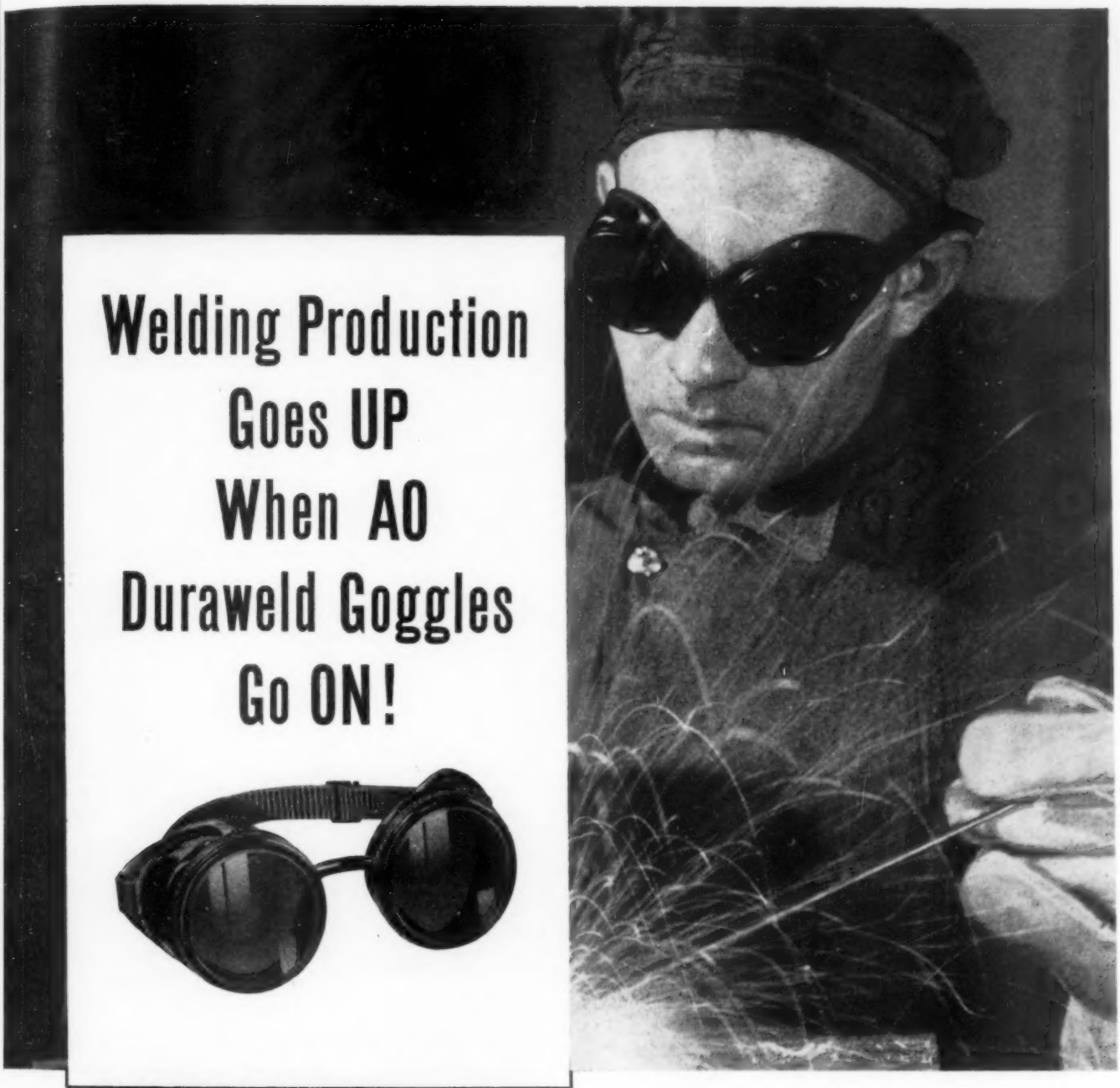

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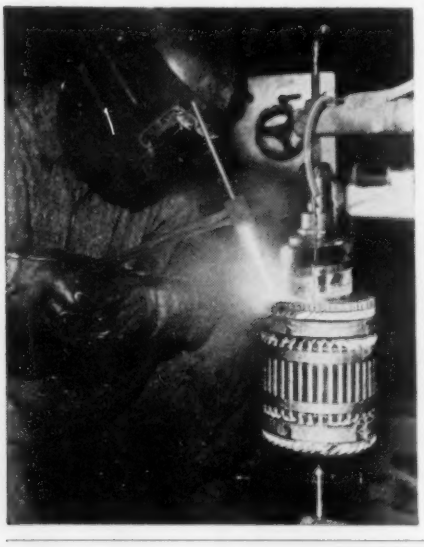
COPPER WELDED TO COPPER UNDER STREAM OF WATER

Welding steel to steel has been an important factor for increasing strength of power industrial trucks. Now copper is welded to copper in assembling motors for these material-handling huskies by the Elwell-Parker Electric Co., Cleveland, Ohio.

One cause of trouble with electric motors is overload—overheating, melting and displacing solder used to connect wire conductors in the armature. Instead of soldering, connections now are made by carbon-arc welding. This, while a stream of water is played on the metal to keep down temperature.

Melting point of copper is three to four times higher than that of solder. It also is higher than the heat generated in an armature in severe service.

In a 3- to 5-hp. motor as many as 65 separate welds are made, closely, evenly spaced. These connect the tips of the short lengths of wire conductors in the commutator bar neck slots, at both ends of the armature coils. The wires are heavy, rectangular in cross section; end to end they would reach out to a length of 143 ft.



All wires are insulated up to the points where they are joined after being assembled in the armature. Insulations must be protected from heat applied to melt the copper. This is accomplished by means of the water jet, led in a rubber tube to the parts near the electrode. Excess heat is localized and dispersed in the form of steam.

The welder now works with both fire and water, balancing the two, as one moment the copper must be fluid, and the next solid. Armature is mounted vertically on its shaft on a work bench and the welder rotates it, bringing one spot after another before him as he performs his magic.

Fiberglass and asbestos in threads and tape now are used for insulations, contributing to the success of the process. Glass and asbestos insulated field coils result in practically enclosed, fireproof motors. Elwell-Parker motors have no fuses; are built to absorb all the current a truck's batteries will deliver.

More skill, time and cost are required in the welding than in soldering, but it is a positive improvement making certain longer life for motors.

HERE IS YOUR INFORMATION

The latest edition of *Here Is Your Information (AM-30)*, an illustrated four-page bulletin published by Eutectic Welding Alloys Corp. is now available. This attractive and clear-cut bulletin contains concise information on the outstanding welding rods for use in every shop.

To facilitate its usefulness, the bulletin has been scientifically arranged according to metals and lists those rods which are designed specifically for each metal application. Listing tensile strength, bonding temperatures, sizes available and outstanding characteristics of each rod, the bulletin is a handy reference for all welders.

The information contains exact suggestions for avoiding high heat welding problems, stresses methods for lessening distortion and is an over-all, small-size manual for quality welds for all shops, both for repair and production.

Secure your copy by writing to Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N..Y.

TESTING MACHINE

Bulletin 282, 4 pages, 8½ x 11 in., describes and illustrates Baldwin-Tate-Emery Universal Testing Machine Models 20-35 and 60-35 with respective capacities of 20,000 and 60,000 lb. These machines apply and measure loads hydraulically using precision lapped-ram construction in conjunction with 3-range Tate-Emery Null Method Dial Indicators. The bulletin describes the principles of operation, the accessories and gives specifications. Copies are available from the Baldwin Locomotive Works, Testing Equipment Dept., Philadelphia 42, Pa.

INDUCTION HEATING

Advantages of induction heating in the form of increased production and lower processing costs are covered in a new 12-page bulletin which describes features of Allis-Chalmers heaters ranging from 1 to 100 kw. in size.

The new bulletin presents several dozen examples of successful brazing, soldering, hardening, annealing and heating with Allis-Chalmers induction heaters involving a wide diversity of products ranging from refrigerator to automobile and industrial stitching machine parts.

The bulletin calls attention to the company's engineering service available in the form of installation supervision, application engineering, work coil design, and the design of special work handling equipment. It also gives heater specifications and dimensions and touches on the company's line of dielectric heaters, as well as such auxiliary equipment as power transfer switches, sealed water systems and work tables available from Allis-Chalmers.

Copies of the bulletin, "Allis-Chalmers

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Sure thing for a perfect weld

HERE it is! A welding ring that *really* helps the pipe welder in *economically* attaining complete penetration to the root of the joint. It's the new Tube-Turn groove type welding ring, with knock-off spacer pins that *assure* adequate, uniform and constant root gap spacing.

The pins maintain correct root gap spacing during tacking and allow for the reduction of the gap caused by shrinkage during laying of the first pass. Pin length is such that commercial variations in pipe diameter *cannot affect their ability to establish and maintain correct root gap spacing.* The pin are simply knocked off after tacking.

The new ring assures maximum ductility of root bead, making the weld more capable of passing the difficult back-bend test. It eliminates tacking ring to pipe idee, because the spacer pins unfailingly center the ring to the joint and prevent the ring from shifting. The venturi shape of the inside surface of the ring cuts flow resistance to approximately two-thirds that of the conventional flat ring, ¾" wide by ⅛" thick.

Tube-Turn groove type welding rings are available at your nearby Tube Turns distributor, in addition to Tube-Turn seamless welding fittings in a wide range of types, sizes, metals and alloys. For fast service in good connections, specify "Tube-Turn."

TUBE TURNS, INC.

222 E. Broadway, Louisville 1, Ky.

District Offices at New York, Philadelphia, Pittsburgh, Detroit, Chicago, Houston, Tulsa, San Francisco, Los Angeles

TUBE-TURN

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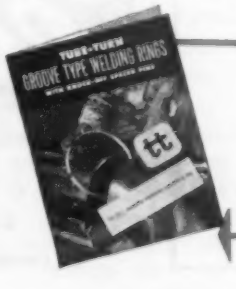
WELDING FITTINGS AND FLANGES



For complete information about the newest and greatest improvement in welding ring design, write for folder: "Tube-Turn Groove Type Welding Rings."

ACRO REORGANIZED

A group headed by J. C. Wilson, Jr., has acquired the Acro Welder Mfg. Co., Milwaukee, Wis., according to a recent news release.

The company manufactures spot, seam, projection and portable gun resistance welding machines and brazing machines. The new organization plans to expand engineering and production facilities, make design changes and supplement the Acro line, and distribute Acro machinery on a nation-wide basis.

Wilson, who formerly was executive vice-president and director of the Burlington Mills, Inc., Burlington, Wis., was elected president. Other officers are L. R. Matthews, vice-president; W. C. Messinger, secretary; J. C. Wilson, Sr., treasurer; and T. B. Wilson, assistant secretary-treasurer.

OXYGEN IN THE STEEL INDUSTRY—PAST, PRESENT AND FUTURE

The Air Reduction Sales Co. has announced the availability of a new article reprint entitled, "Oxygen in the Steel Industry—Past, Present and Future." The article, which originally appeared in *Blast Furnace and Steel Plant*, was written by G. V. Slottman, technical assistant to the vice-president, a recognized authority on the metallurgical applications of oxygen and other gases.

The article provides additional data on oxygen uses in the steel industry including the development phase, combustion and metallurgical uses and concludes with a summary of open-hearth uses of oxygen.

For a free copy of this new reprint write Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., or the Airco sales office nearest you.

JOB WELDING BULLETIN

Of interest to contract sheet metal fabricators is a 2-page bulletin (Bulletin No. 1001) now available from Progressive Welder Co., 3050 E. Outer Drive, Detroit 12. Illustrated herein are a number of different types of parts which are being fabricated by contract shops more quickly and at lower cost with standard resistance welding equipment.

Included are "blueprints" and photos of such typical parts as hardware, fans, moldings, containers, wire shelving, skates, spray tanks, universal joint couplings, soap dispensers, petcock wrenches, streamlined pipe stems, etc., all of them examples showing what is being done with standard resistance welding equipment on a job-lot basis. Seam, spot, butt, projection, and stick welding were used in the examples listed.

RESEARCH IN INDUSTRY, ITS ORGANIZATION AND MANAGEMENT

Edited by C. C. Furnas, Director, Cornell Aeronautical Laboratory. Published by the D. Van Nostrand Co., 250 Fourth Ave., New York 3, N. Y. Price $6.50.

Through this book the thoughts and experiences of a number of successful executives with long-standing research experience, representing a good cross section of American industry, are made available to those who have an interest in the organization and management of industrial research activities.

The book starts off with a philosophy of objectives of research in industry. It then covers the research laboratory as an operating department of the company. Other chapters deal with the research director's job, organization charts, selecting projects for research, the research budget, research reports, procurement and selection of research personnel, salary and personnel policies, the location, design, construction and equipment of a modern research laboratory, service personnel and facilities, translating research results into new products, evaluating the results of research, and a host of other valuable chapters. It is an encyclopedia of information on the subject of Research in Industry.

INVESTIGATION OF FLEXURAL FATIGUE STRENGTH OF STEEL BEAMS

The University of Illinois Engineering Experiment Station at Urbana is now distributing Bulletin 377, *Flexural Fatigue Strength of Steel Beams*, by Wilbur M. Wilson. Copies may be obtained free, upon request, for a limited period from this Station.

The research was conducted by this Station in cooperation with the Public Roads Administration, Federal Works Agency; The Chicago Bridge and Iron Co.; Association of American Railroads; and the Bureau of Ships, Navy Department.

The investigation was carried out under the supervision of the Committee on Fatigue Testing (Structural) of the Welding Research Council, The Engineering Foundation, sponsored by the AMERICAN WELDING SOCIETY, and the American Institute of Electrical Engineers.

The text contains 18 tables and is accompanied by a sketch of the 200,000-lb. fatigue machine adapted to test flexural specimens.

The author's "Summary" on pages 30–32 gives ten main findings. He says: "The outstanding feature of the results is the very large reduction in the fatigue strength due to abrupt changes in section at the ends of partial-length cover plates."

POCKET ELECTRODE GUIDE

Air Reduction Sales Co. has announced the publication of a new pocket guide to Airco arc welding electrodes.

This handy, compact guide presents all the facts pertaining to the most commonly used Airco electrodes along with helpful data regarding the factors to be considered when choosing an electrode for a specific job.

The profusely illustrated, 4 x 8 in. guide is thumb-indexed for ready reference. Section titles include mild steel, high tensile steels, low hydrogen weld metal, stainless steels, surfacing, nonferrous and cast iron. The information on each electrode mentioned in the new guide includes description, recommended application and welding procedure.

Also included in the helpful guide is an easy-to-read electrode selection table which gives the operator complete information on which electrode to use for a particular job, its chemical analysis and mechanical properties.

The guide also features a two-page N.E.-M.A. standard color marking chart and an electrode comparison chart which matches up the various electrodes on the market with their respective A.W.S.-A.S.T.M. classification.

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BRASS *Handles*

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LARGE STOCK
PROMPT DELIVERY

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Time Counts—
Gas cut and Weld with

Shawinigan Carbide

SHAWINIGAN

SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING, NEW YORK 1, N.Y.

According to the manufacturer, the guide will prove to be a valuable reference aid to anyone whose work is connected with electric arc welding.

For your free copy of the Pocket Guide to Airco Electrodes, write Dept. A19-24P, Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., or the Airco sales office nearest you.

FABRICATING SEMIPRECIOUS METALS

Classifying stainless steel, nickel, Monel and Inconel as semiprecious metals, Storts Welding Co., Inc., Meriden, Conn., has issued an illustrated bulletin featuring various types of plant equipment of special design fabricated in these metals. The fabrications shown include plating and rinsing tanks, processing tanks, annealing hoods, trays and baskets, piping and duct work and material handling equipment—all for service where corrosion resistance, heat resistance or both are required. The advantages and the fields of application of the semiprecious metals are noted and suggestions are given for supplying information to the fabricator when inviting estimates on special equipment for corrosion and high temperature conditions.

RESISTANCE WELDING BUSINESS

Already having exceeded, in the first quarter of 1948, the total annual volume of shipments just prior to the war, the Resistance Welder Manufacturers Association reports a further gain in orders received during April. New orders placed with Association members for spot, seam, butt and projection welding equipment were 10% higher during April than in March and actually exceeded the high level of deliveries maintained during April, according to H. R. Rinehart, Secretary-Treasurer of the Trade Association. As a result, backlog of orders on hand showed a further gain.

In line with the rapidly increasing use of resistance welding to fabricate all types of metal products—eliminating bolts, rivets, etc.—shipments of welding electrodes for resistance welders also showed a gain of 14% in April over March, the Association reports. Most of these electrodes are used to replace those consumed on machines in service.

WELDING STAINLESS STEEL

Welding and Soldering of ARMCO Stainless Steels is a 52-page handbook containing information on oxyacetylene, metal-arc, resistance, pressure, submerged arc and other methods of welding stainless steel. Book is attractively printed in two colors and profusely illustrated with photos, drawings and charts. Sections on soft soldering, silver brazing, riveting and oxygen cutting are also included. Write to Armco Steel Corp., Middletown, Ohio, for a copy of this book.

NOW -the New

Tri-Phase
TAYLOR-WINFIELD WELDERS
(RESISTANCE)

Tri-Phase can be had in spot, projection, seam or upset-butt welders. Shown is a T-W Tri-Phase Spot welder.

Greater Electrical Efficiency and Improved Welding Performance

POWER SUPPLY FEATURES

1. *Greatly reduced power demand.*
2. *Three phase balanced power load.*
3. *Desirable high power factor.*

DESIRABLE D. C. WELDING CURRENT

1. *More work—same welder—deeper throat depths—with essentially no increase in power demand.*

FLEXIBILITY AND VERSATILITY

1. *Can weld low carbon steel, stainless steel, aluminum, magnesium, monel, inconel, brass alloys and other materials on same welder.*

HIGH PRODUCTION EFFICIENCY AND LOW MAINTENANCE COST

Tri-Phase welders are simple, accessible and easy to maintain, and operate with simplified controls.

Full information on new Tri-Phase T-W welders sent promptly upon request. Ask for Bulletin 10-813, just off the press, or call the T-W sales engineer in your territory.

Our monthly publication "Weld-It" shows many production short cuts by resistance welding. Request it using your company letterhead.

Tri-Phase
TRADEMARK
THE TAYLOR-WINFIELD CORPORATION
WARREN, OHIO, U. S. A.

TAYLOR-WINFIELD
RESISTANCE WELDERS

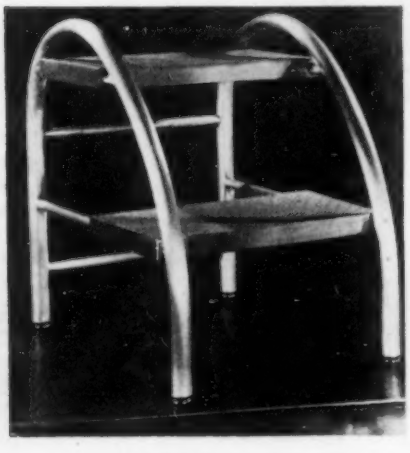
AIR REDUCTION PUBLISHES DESCRIPTIVE FOLDER ON AVAILABLE WELDING INSTRUCTION BOOKS

The Air Reduction Sales Co. has announced a descriptive folder which describes in detail their five available welding and cutting instruction books.

According to the publisher, these books, crammed full of material based on Airco's thirty years of experience in the welding and cutting field, will prove valuable informational and instructional sources for students, instructors, professional welders and design engineers.

Two volumes are devoted to arc welding, and two to oxyacetylene welding and cutting. The fifth book is *Manual of Design for Arc Welded Steel Structures*, a 300-page definitive work, the first of its kind ever published.

For a copy of the descriptive folder on these books, write Department A19-24 P or the Airco sales office nearest you.



HOW TO BE SAFE ON A STEPLADDER

In the current model of the Even Vault Step pictured above, safe sturdiness has been achieved along with good looks and lightness by low-temperature welding. All the parts are aluminum and are welded with All-State No. 31 Aluminum Brazing Alloy. The Step is manufactured by A. D. Even Co., Pleasant Ridge, Mich.

O'BRIEN ELECTED DIRECTOR

Frank J. O'Brien, President and Director of Metal & Thermit Corp. and Chromium Corp. of America, has been elected a director of the Norma-Hoffman Bearings Corp.

Mr. O'Brien is also a director of the Hanover Fire Insurance Co., the Fulton Fire Insurance Co., and United Chromium, Inc. Mr. O'Brien is a member of AMERICAN WELDING SOCIETY.

J. J. LINCOLN NEW PRESIDENT OF INTERNATIONAL ACETYLENE ASSOCIATION

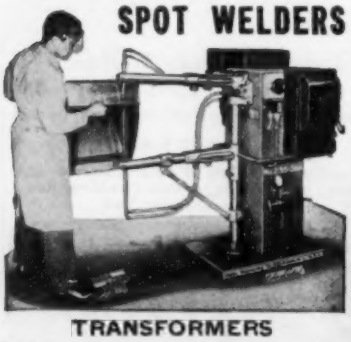
John J. Lincoln, Jr., director of sales services, Air Reduction Sales Co., New York, was elected president of the International Acetylene Assoc. at the Association's recent annual meeting. Mr. Lincoln served as vice-president and member of the Executive Committee of the Association for 1947 and 1948.

A. J. Fausek, president, Modern Engineering Co., St. Louis, was elected vice-president and E. V. David, assistant manager of the Technical Sales Division, Air Reduction Sales Co., New York, was elected treasurer. H. F. Reinhard was re-elected secretary. R. B. Swope, president, Southern Oxygen Co., Inc., and retiring president, was elected a director. Henry Booth, vice-president of Shawinigan Products Corp., New York, and C. McL. Pitts, president, The Peoples Gas Supply Co., Ltd., Ottawa, Ont., were re-elected directors for three years.

John J. Lincoln, Jr., was born in Elkhorn, W. Va. He attended Yale University and was graduated from the Sheffield Scientific School in 1924 with a B.S. degree. He joined the Air Reduction Sales Co. in 1924. After serving as a salesman and as manager of the Bettendorf and Pittsburgh Sales Districts, Mr. Lincoln was appointed assistant sales manager in 1937. In 1945 he was appointed to his present position of director of sales services.

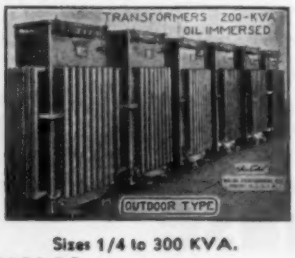
ALBERT McMILLAN RECEIVES MOREHEAD MEDAL FOR 1947

The 1947 James Turner Morehead Medal has been awarded to Albert McMillan of Shawinigan Chemicals, Ltd., Montreal. He is receiving the medal for his outstanding pioneering work in building and in operating efficiently some of the first major acetylene generating plants in the industry's history. The medal was presented to Mr. McMillan during the opening session of the 50th Anniversary



SPOT WELDERS

OF ALL TYPES
SIZES 1/4 TO 300 KVA.
FOR MANUAL, AIR, MOTOR, OR ELECTRONIC OPERATION
also BUTT, ARC, and GUN WELDERS



TRANSFORMERS

For Furnaces, Lighting, Distribution, Power, Auto Phase Changing Welding, and Special Jobs.
AIR OIL, and WATER COOLED.
Sizes 1/4 to 300 KVA.

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EISLER ENGINEERING CO., INC.
779 South 13th St. (Near Avon Ave.) NEWARK 3, N. J., U.S.A.

Buy "PROVEN FLUXES"
Years of GUARANTEED SATISFACTION behind these GOOD
"ANTI-BORAX" FLUXES

Insist on them — Unequalled Quality

No. 1 Cast Iron Welding Flux
No. 2 Brazing Flux for Brass, Bronze, Steel, etc.
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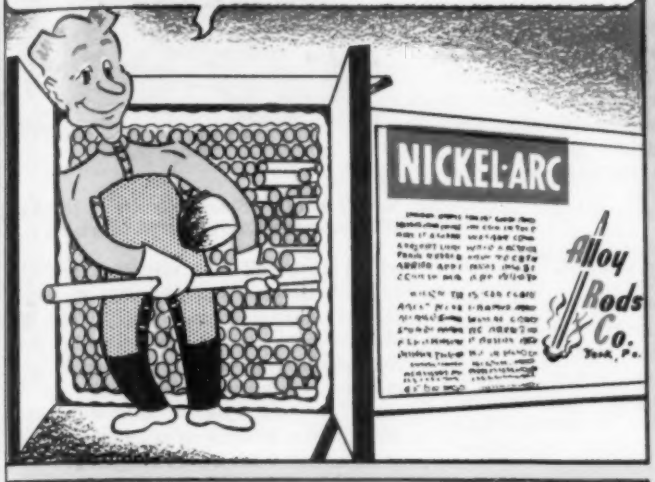
No. 5 & 8 Cast & Sheet Aluminum Fluxes
No. 9 Stainless Steel Welding Flux
No. 11 Tinning Compound
No. 16 Silver Solder Paste Flux

Mfg. By
ANTI-BORAX COMPOUND CO., INC.
Fort Wayne, Ind.

SPARKY "tells all" about NICKEL-ARC

MEET MY FAVORITE ELECTRODE FOR AC OR DC CAST IRON WELDING. IT COMES IN THIS HANDY 10 LB. PACKAGE.

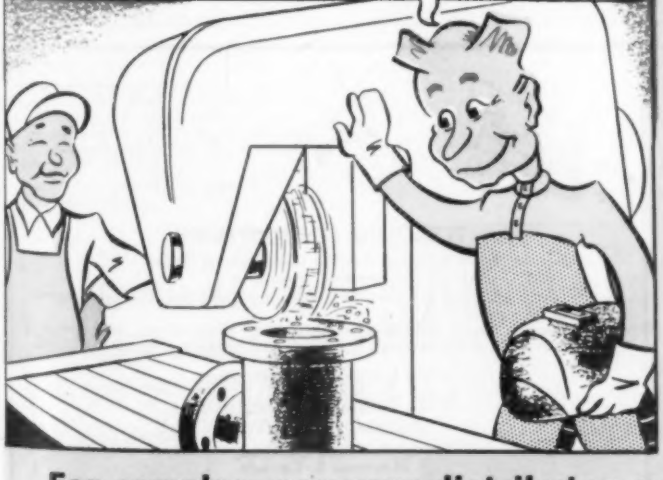


WATCH HOW NICKEL-ARC MAKES THIS CRACKED CASTING GOOD AS NEW . . . FIRST, I OPEN UP THE CRACK . . .

DIRT AND GREASE REMOVED — NOW THE CASTING IS READY TO WELD. THERE'S NO PRE- HEATING WITH NICKEL-ARC.

SMOOTH-RUNNING? YOU BET! AND THERE ARE NO INJURIOUS OR HARMFUL GASES TO WORRY ABOUT.

HERE'S THE PAY-OFF. THE NICKEL-ARC DEPOSIT IS A CINCH TO MACHINE — AND COMPLETELY FREE OF POROSITY.



PERFECT COLOR MATCH, TOO. YEP, NICKEL-ARC'S WELD DEPOSIT MATCHES PERFECTLY THE COLOR OF THE PARENT METAL.

For samples, see your distributor or write Alloy Rods Company, York, Pa.

Albert McMillan

Convention of the International Acetylene Assoc. which was held at the Book-Cadillac Hotel in Detroit, May 3rd and 4th.

The Morehead Medal is awarded annually by the International Acetylene Assoc. to the person or persons who, in the judgment of its officers and board of directors, have done most to advance the industry or the art of producing or utilizing calcium carbide or its derivatives, the most important of which is the gas, acetylene.

The medal was established by John Motley Morehead in 1922 in honor of his father James Turner Morehead, who sponsored the experiments leading, in 1892, to the discovery of the electric furnace method of producing calcium carbide. Since then the medal has been awarded annually to those who have made outstanding contributions to the acetylene industry.

Mr. McMillan, of Scottish descent, was born Dec. 7, 1875, at Hillsburg, Ont. He entered the industry Sept. 1, 1912, at the Shawinigan Plant. Early in World War I, acetone, a normal by-product of wood distillation and an important ingredient of the explosive used by Britain was in very short supply. Chemists and scientists came to Shawinigan with a proposal to produce acetone synthetically from acetylene. This was McMillan's great opportunity. It was his job to work out seemingly insurmountable problems concerned with engineering, operating and the design and construction of acetylene generating equipment. McMillan produced results—and those results were just the beginning of what is now a tremendously important industry.

In his speech of acceptance at the Book-Cadillac Hotel on May 3rd, Mr. McMillan said: "That original generation of 50 tons of calcium carbide per day into acetylene has been doubled many times over, and the end is far from sight. Our acetylene industry has a future that can scarcely be comprehended."

WELDER FEATURES COMPACT DESIGN

A new portable welder of the gasoline engine-driven type, especially designed to bring to the welding industry a very inexpensive, complete, light weight portable welder for the price normally paid for the welding generator alone, is announced by The Lincoln Electric Co., Cleveland, Ohio.

Of particular value for welding applications in areas where electric power is not readily available such as garages, job shops, repair shops, oil and gas fields and construction work this 180-amp. welder, known as the "Lincwelder," is of exceptionally compact design, roughly 2 ft. wide, 2 ft. high, 4 ft. long and weighing much less than the usual equipment of this type and size.

With a current range of from 20 to 180 amp., the machine can be used for the welding of light or heavy gage metal, for the repair of cast iron structures, etc.

This new welder has many new and unique features such as the following:

1. Provision is made on the output panel for three ranges of output current, continuous adjustment within these ranges being obtained by means of a simple speed control.

2. Generator controls are mounted inside an enclosed cabinet above the generator, cooling being through a fan mounted on the generator shaft.

3. The welder is powered by a Wisconsin air-cooled, 2-cylinder engine. Shrouds around the engine fan and cylinders direct the cooling air. The speed of the engine determines the welding current

New Lincoln "Shield Arc Jr.," 180-Amp. Welder of the Engine-Driven Portable Type

which is controlled by adjusting the engine speed between a maximum of 2300 rpm. (13 hp.) and 1800 rpm. (11 hp.). This type of drive not only reduces weight but eliminates the necessity of winter care of radiator. Equipped with a 3½-gal. capacity gasoline tank, the unit will operate under normal welding conditions for approximately 6 hr. before refueling.

4. Mounting rails for bolting to floor or platform permit the welder to be mounted on either shop trailer or high-speed, road-type, two-wheel trailer.

Net weight of the new "Shield Arc Jr." engine-driven welder is 502 lb., shipping weight being 552 lb.

WELDED WATER PIPE

More than 10 miles of electric-welded steel water pipe has been installed at the vast new New York International Airport at Idlewild in Queens. It was manufactured by the Alco Products Division of the American Locomotive Co. at Dunkirk, N. Y.

Hugh M. Corrough, director of Alco Products, said that the pipe was delivered in record-breaking time. First work on the pipe was started last June and the entire order was ready for shipment in October. Deliveries were made as rapidly as the pipe could be installed and this phase of the project was completed in December.

The pipe order, valued at more than a million dollars, consisted of 35,000 ft. of 30- by ½-in. electric welded steel pipe and 15,500 ft. of 36- by ½-in. electric welded steel pipe.

WALTER C. REED

CONSULTING ENGINEER

(Formerly of General Electric Co.)

Brazing, Soldering Alloys & Fluxes

Metal Joining Methods

Dalton, Mass.

WELDING CONNECTORS

Saxe System Welded Connection Units for welded assembly

Saxe Units place in position and securely hold together structural parts to be welded.

As used in many welded structures they *eliminate all hole punching*, producing an economical, rigid, safe and quickly erected structural frame.

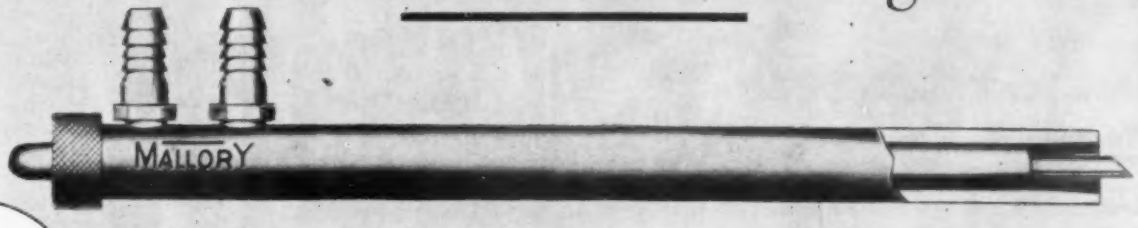
Write for descriptive literature

J. H. Williams & Company
Buffalo 7, New York

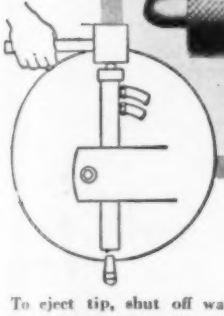
G. D. Peters Company
Montreal 2, Canada
Canadian Representatives

RESISTANCE
WELDING ELECTRODE
HEADQUARTERS
ANNOUNCES

A Straight Light Duty Ejector Holder of new LEAKPROOF Design



Holders made in three body diameters—⅝", ¾" and 1". Barrel length 8" with 1" morse taper tip socket.



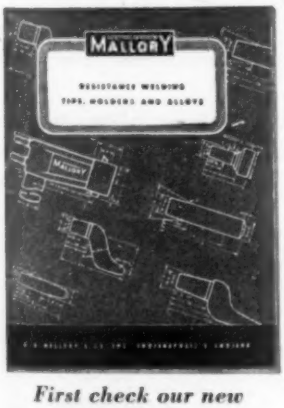
To eject tip, shut off water and strike squarely with mallet, as shown.

Extra electrode life is insured by a water circuit designed to force water against the head of the tip regardless of length and *eliminate leakage* through any part of the holder.

The ejector plug simplifies tip removal, reducing the risk of damaging tips or holders.

The holder will stand up in rough service because the complete barrel is made of Mallory 3 metal, the alloy you know as having highest electrical conductivity and physical strength.

This improved holder, designed and built by Mallory, typifies Mallory leadership in the solving of problems related to the increasing use of Resistance Welding. Mallory is the only supplier of Resistance Welding electrode materials with a completely equipped research laboratory and engineering department specifically devoted to designing and testing improved methods and equipment.



First check our new 1948 catalog—

"Mallory Resistance Welding Tips, Holders and Alloys."

It contains everything you want to know about Mallory standardized welding electrodes, holders, replacement parts, accessories, seam welding wheels, dies, and special alloy applications for Resistance Welding.

If your needs aren't there—get in touch with Mallory direct.

In the United Kingdom, made and sold by MALLORY METALLURGICAL PRODUCTS, LTD. (An Associate Company of Johnson, Matthey & Co., Limited, Hatton Garden, London, E.C.1.)

THE PIONEERS OF ELKONITE*, ELKALOY A*, MALLORY 3*, MALLORY 53B and MALLORY 100 METALS.

P. R. MALLORY & CO. Inc.

MALLORY RESISTANCE WELDING MATERIALS

ELECTRODES—HOLDERS—SPECIAL DIES AND FIXTURES—
ELKONITE* METALS—ALLOY ROD AND BAR STOCK—
FORGINGS—CASTINGS—ACCESSORIES *REG. U. S. PAT. OFF.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Ten Miles of Pipe for New Airport

Many unusual steel pipe manufacturing features were built into the airport pipe, including special bends and angles. The pipe was coated and wrapped in 40-ft. lengths, except for a few 30-ft. lengths than were designed to meet abrupt changes in grade and alignment.

Downer, Green and Carillo was the engineering and contracting firm in charge of the installation; E. J. Carillo being the resident partner. A. C. Perkins is chief engineer of the firm and was in charge of all construction. In charge of the pipe laying were James A. Donovan and P. Tomasetti, general manager and chief engineer of the T. and T. Co. of Brooklyn.

Stainless Steel Industry Exhibit

Stairway to the Future. Graceful curves denote design of stainless steel staircase, featured at permanent Stainless Steel Industry Exhibit, now open to the public at 101 Park Ave., New York. From Jewelry to massive industrial vats and tanks, this modern metal has applications in scores of present-day industries. U. S. tonnage has increased from 42,000 tons in 1929 to over 500,000 last year.

STAINLESS STEEL EXHIBIT

Stainless steel production in the United States has increased from 42,000 tons in 1929 to over 500,000 tons last year, George S. Rose, Secretary of American Iron and Steel Institute, told steel men and press representatives who attended a preview of a permanent Stainless Steel Industry Exhibit.

The Exhibit, sponsored by the Institute, will be open to the public without charge. It is located in the Architects' Samples Building, 101 Park Ave., where it occupies part of the ground floor and mezzanine.

A sweeping stainless steel staircase is the major architectural feature of the Exhibit, which contains displays of stainless steel making and fabricating processes, and of hundreds of finished items made of the metal.

"The term stainless steel denotes a large family, a group of some 30 alloy steels which resemble each other yet differ widely in characteristics and use," Mr. Rose said.

"The family resemblance is based on the fact that all stainless steels contain chromium in addition to the iron and carbon present in all steels. It is the chromium in this combination that makes the steel stainless. Nickel is an important component of many grades of stainless.

"Advantages of stainless steel have opened a new vista of industrial and commercial development. Its great resistance to heat and corrosion, high strength, enduringly beautiful finish and lasting customer appeal have stimulated the ingenuity of manufacturers and designers."

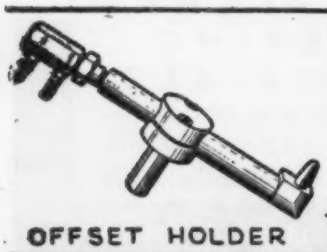
The preview of the Stainless Steel Industry Exhibit was preceded by a luncheon at the Union League Club.

Save by Redesign

Stainless steels often save money on the basis of first cost, because architects, engineers and designers know how to take advantage of the high strength of this material. With proper design, sections may be lightened and still provide ample structural strength.

Engineers supplement the inherent high yield strength of specially processed stainless grades by welding or riveting stiffeners to the structure. These stiffeners provide greater rigidity for the light stainless steel sheets, often making it possible to cut the weight of a product in two.

Because cost is a primary consideration the stainless steel type selected should be

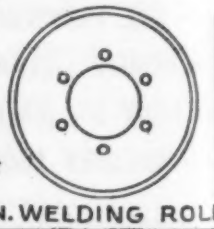


"ELECTROLOY" for RESISTANCE WELDING

Butt
Flash
Spot
Seam
Projection

ELECTROLOY

Catalog and prices on request



THE ELECTROLOY CO. INC. 1600 SEAVIEW AVE. BRIDGEPORT, CONN.

no higher in alloy content than requirements demand. To use stainless steels effectively and economically it is necessary to choose the right type for each application.

Development of the Market

The growth of the stainless steel industry is well expressed in ingot tonnages. In 1929 the figure was 42,000; by 1936 it had reached 101,000 and in 1947 it was over 500,000 tons.

The turn of the decade in 1930 saw the markets for stainless steels becoming more and more diversified. New uses came to life as one industry after another investigated the possibilities of this rustless steel.

Many New Uses

The oil industry, confronted with the corrosion problems of mid-continent crude oils, was quick to adopt the new stainless steels for use in cracking towers and other equipment.

The dairy, textile and paper industries quickly recognized its economy and usefulness. Chemical processing industries turned to stainless steel for many large-scale installations. The food industries and dozens of others followed suit.

Automotive Applications

At another important milestone, Henry Ford introduced stainless steel on the dashboards of the Lincoln automobile in 1928, and on the radiator and hub caps of his new "Model A" Ford in 1930. This marked a sensational advance in the automotive field which others were quick to adopt. Today's automobiles have a dozen or more stainless steel parts in engine and body, which enhance their efficiency and beauty.

In World War II, stainless steel proved invaluable for military uses. Its resistance to rust under the severest atmospheric conditions and the rigors of tropical and frozen climates was quickly recognized.

High strength and resistance to heat and corrosion were qualities which established its urgent need on ships and aircraft. The demands of war resulted in ever-widening acceptance of stainless steel, with a resultant increase in the number of applications. Many of these have since been adapted to peacetime uses. But the development of military applications has continued, especially in rockets, jet-propelled planes and other aircraft.

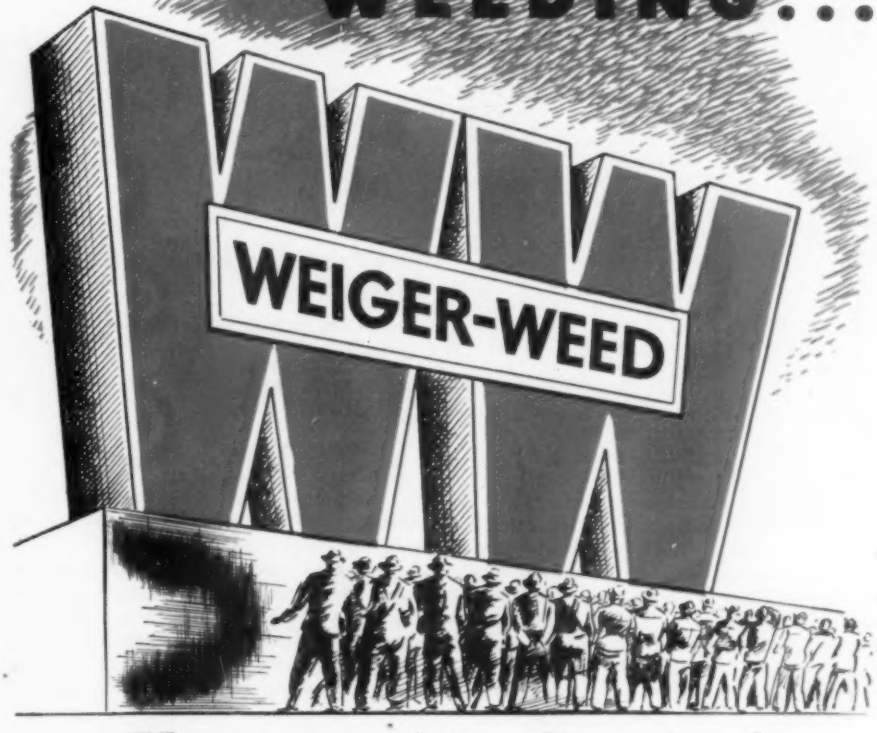
Readily Fabricated

Stainless steels of proper composition are available for products which may be fabricated by any of the methods used for carbon steel.

Flat-rolled stainless steel is drawn as deeply as the finest deep-drawing carbon steel. It can be spun or formed readily. Bar and wire can be cold-worked or hot-forged into any required shape and machined with ease. Stainless steels are welded by oxyacetylene, metal arc, resistance, pressure, atomic hydrogen and inert arc methods.

Fabricators of stainless steel, who make

RESISTANCE WELDING . . .



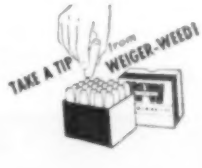
. . . . *Knows this Symbol*

Since early 1946, users of resistance welding have come to recognize Weiger-Weed as the progressive company, the company that grows with the industry, that keeps to the front with time-saving and cost-saving developments.

The personnel of Weiger-Weed, both at the plant and in the field, is made up of men who pioneered in the development, application and manufacture of copper base alloys for resistance welding. The knowledge and experience of these men is backed by the resources, facilities and metallurgical experience of the Fansteel research staff, all working together to serve you.

Weiger-Weed places at your service its special engineering and production skills to help your production engineers to obtain more and better welds at lower cost. Write for recommendations on your problems. Weiger-Weed & Company, Division of Fansteel Metallurgical Corporation, 11644 Cloverdale Ave., Detroit 4, Mich.

Weiger-Weed produces high quality spot welding tips, holders, seam welding wheels, and special dies for flash, butt and projection welding. Deliveries are prompt; standard electrodes and holders supplied from stock.



Ask for your copy of the Weiger-Weed manual to become familiar with Weiger-Weed products and service, to help you turn out stronger, lighter, more easily fabricated products at lower cost.

WEIGER-WEED
TRADE MARK
Resistance Welding ELECTRODES
DIES • TIPS • WHEELS • HOLDERS
DIVISION OF FANSTEEL METALLURGICAL CORPORATION

Stainless Steels—A.I.S.I. Types

Type Number	Chromium	Nickel	Other Elements
301	16.00/18.00	6.00/8.00	...
302	17.00/19.00	8.00/10.00	...
302B	17.00/19.00	8.00/10.00	...
303	17.00/19.00	8.00/10.00	P, S, Se Min. 0.07, Zr, Mo Max. 0.60
304	18.00/20.00	8.00/11.00	...
308	19.00/21.00	10.00/12.00	...
309	22.00/24.00	12.00/15.00	...
310	24.00/26.00	19.00/22.00	...
316	16.00/18.00	10.00/14.00	Mo 1.75/2.75
321	17.00/19.00	8.00/11.00	Ti 5 x C Min.
347	17.00/19.00	9.00/12.00	Cb 10 x C Min.
403	11.50/13.00	...	Turbine Quality
405	11.50/13.50	...	Al 0.10/0.30
406	12.00/14.00	...	Al 3.50/4.50
410	11.50/13.50	...	...
414	11.40/13.50	1.25/2.50	...
416	12.00/14.00	...	P, S, Se Min. 0.07, Zr, Mo Max. 0.60
420	12.00/14.00	...	...
430	14.00/18.00	...	...
430F	14.00/18.00	...	P, S, Se Min. 0.07, Zr, Mo Max. 0.60
431	15.00/17.00	1.25/2.50	...
440A	16.00/18.00	...	Mo 0.75 Max.
440B	16.00/18.00	...	Mo 0.75 Max.
440C	16.00/18.00	...	Mo 0.75 Max.
442	18.00/23.00	...	...
443	18.00/23.00	...	0.90/1.25 Cu
446	23.00/27.00	...	N_2 0.25 Max.

thousands of useful and decorative articles, have contributed much to its development. Many enterprising business men have gained their first acquaintance with the market possibilities of stainless steel during World War II. Some were civilians, some in uniform.

There are about 5000 job-fabricators of stainless steel in the country, and the number continues to grow.

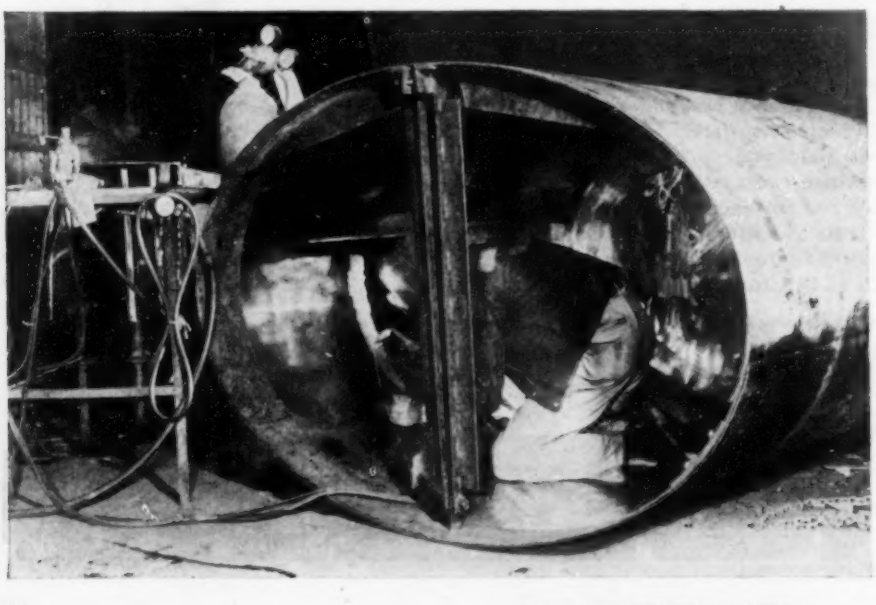
HELIARC WELDING OF STAINLESS STEEL TANKS

Stainless steel trailer tanks have long been used for transporting milk. The Heliarc inert-gas-shielded arc-welding process has simplified the fabrication of the tanks illustrated. High purity argon gas shielded the torch electrode and weld area thus eliminating the use of flux. These tanks are made from 14-gage, type 302, stainless steel and each one has a capacity of 1000 gal. Each tank has 912 in. of welding and required approximately 45 min. of actual welding time.

The high sanitary standards required for such containers are easily met with Heliarc welding. There is no flux to cause spatter and corrosive inclusions. Dirt and other contaminating substances will not lodge in the smooth, nonporous welds produced by this method.

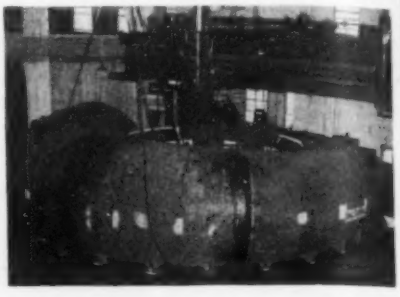
The inert-gas-shielded arc-welding process has made rapid strides in the fabrication of nearly all types of metals. In this process the electrode and the weld are blanketed by argon, an inert gas. An outstanding characteristic of the process is that, with the exception of copper, flux is not required in the welding of any of the common commercial metals and alloys.

With the Heliarc process, welds are easy to start and stop without crater-crack difficulties, and filler metal can be easily added and controlled. The heat input is low and therefore little distortion results. Grinding and finishing operations are simple when compared to other methods of welding.



POWER FOR THE WEST COAST

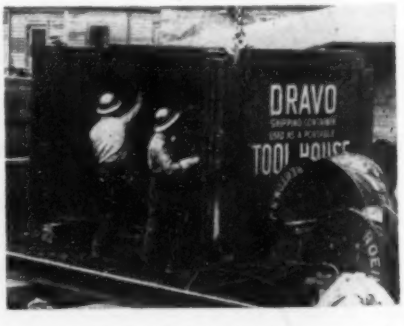
Added power for the West Coast is in the making. These cranes were required to lift this 360,000 lb., welded-construction spiral casing for the fifth Shasta Dam hydraulic turbine to a 40-ft boring mill in the Allis-Chalmers shops for machining of its speed ring. This casing measures 56 ft across. It is constructed in seven sections with riveted buttstrap joints. Its speed ring portion has an 18-ft. inside diameter.



The inlet section, fading toward the far wall at the left end of the casing, has an inside diameter of 12 ft. 8 in., and is made of $1^7/_8$-in. plates. Upon completion, the unit will be shipped to join four other Allis-Chalmers turbines at Shasta, all rated 103,000 hp. at $138^1/_2$ rpm. under 330 ft. head.

TOOL BOX

Virtually a "safety deposit box" for tools and equipment on outdoor construction projects is this 277-cu. ft. welded steel shipping container developed by Dravo Corp., Pittsburgh. Although primary use of such containers is in marine and rail transportation to eliminate pilferage and reduce material handling and packaging costs, the Contracting Division of Dravo Corp. found them to be ideal as portable tool houses. The unit pictured



provides weathertight, safe storage for welding equipment and hand tools at the site of a bridge substructure construction project undertaken by the Contracting Division near Pittsburgh. Lifting lugs are built into the top corners of the containers so they can be handled by a crane. Industrial trucks also may be used to move them. Hangars for tools and equipment can be welded to the steel sidewalls or fastened to wood nailing strips placed between wall corrugations. This permits an orderly storage arrangement, and saves the time usually required to sort tools piled in a wooden box. Up to 6 tons of tools and equipment can be transported in the container.

PAGE *Welding* ELECTRODES

C+X=S
WHERE:
C= COMPLETE RANGE OF ELECTRODES AND GAS WELDING RODS
X= EXPERIENCED FIELD SERVICE MEN TO RECOMMEND CORRECT RODS AND TECHNIQUES
S= SAVINGS IN WELDING COSTS

This is the PAGE formula for economy in production welding. The uniformly high quality of PAGE welding electrodes and rods is not included, because that is simply taken for granted by experienced welders.

Through PAGE Field Service Men, your PAGE distributor can give you valuable up-to-date information on welding techniques and selection of electrodes. That's why we say . . .

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TRADE MARK

Group 1

R.W.M.A. VISITS R.P.I.

When the Resistance Welder Manufacturers Association completed their business session in Troy, N. Y., on Friday, May 21, they split into two sections for a tour of the welding laboratories at Rensselaer Polytechnic Institute. It was with this project in mind that the spring meeting was held in Troy. Group 1 is in one of the basement labs of R.P.I. Left to right they are Clyde Kaunitz, Resistance Welder Company, Bay City, Mich.; H. B. Warren, Thompson Electric Welder Co., Lynn, Mass.; Robert Curran, research fellow at R.P.I.; H. D. Weed, Weiger Weed & Co., Detroit; H. R. Rinehart, secretary-treasurer of R.W.M.A., Philadelphia; J. C. Deffenbaugh, Federal Machine & Welder Co., Warren, Ohio; R. H. Taylor, Electroloy Co., Inc., Bridgeport, Conn.; T. S. Long, Taylor-Winfield Corp., Warren, Ohio; N. G. Bostwick, Precision Welder & Machine Co., Cincinnati; T. Embury Jones, of the same company; and H. A. Mullen, Ampco Metal Inc., Milwaukee, Wis. Mr. Long is president of the R.W.M.A.

A second group of the R.W.M.A. is shown in the fourth-floor laboratory where they had just witnessed a demonstration in projection welding by Wiley J. Childs, research fellow standing second from the left. Seated are J. H. Cooper, Taylor-Winfield Corp.; H. A. Stix, Federal Machine & Welder Co.; E. J. Rousseau, Commerce Pattern Foundry & Machine Co., Detroit; G. N. Sieger, S-M-S Corp., Detroit; and B. L. Wise, National Electric Welding Machines Co., Bay City, Mich. Mr. Wise is vice-president of the association, Mr. Sieger a former president.

Standing at the left is Dr. Wendell F. Hess, head of the R.P.I. department of metallurgical engineering, and next in order are: Childs, mentioned above; F. L. Brandt, of Thompson Electric Welder Co.; A. L. Williams, Federal Machine & Welder Co.; W. G. Fetter, P. R. Mallory & Co., Indianapolis; H. W. Stieglitz, also of the Thompson Co.; Warren F. Savage, formerly research fellow at R.P.I. and now an instructor in welding; Dr. Ernest F. Nippes and Robert A. Wyant, assistant and associate professors in metallurgical engineering.

RESISTANCE WELDING SHIPMENTS

First-quarter deliveries to industry of resistance-welding equipment machines and equipment by members of the Resistance Welder Manufacturers' Association exceeded the total for the best entire prewar year, according to T. S. Long, President of the R.W.M.A.

Compared with an average annual volume of around $4,000,000 in the last peacetime years before the war, the resistance welding industry is currently producing equipment at an annual rate in excess of $25,000,000, Mr. Long said. Most of this growth, Long added, has taken place since the end of World War II and has resulted from Industry's need of finding more efficient, faster and less costly methods of fabricating all types of metal products to offset continuously rising labor costs. Prime difference between resistance and other forms of welding is that it lends itself to mass production of all kinds of articles—from business machines, refrigerators and stoves to heavy farm and road machinery—and that it requires practically no skill on the part of the operator, Long pointed out.

Group 2

OUTSTANDING DEVELOPMENTS IN MODERN WELDING

SW·15

Mild steel SMITHway electrode for high-speed welding in any position with any current

• SW-15 is particularly suitable for difficult operations such as field erection, or where, in the absence of close supervision, high quality welds are desired. With a penetrating and easily directed arc, SW-15 produces unusually smooth welds with sound physical properties. Deposit efficiency is high; slag is exceptionally easy to clean. A.C. or D.C., either polarity. SW-15 gives you cleaner, faster welds with maximum economy.

Made by Welders... for Welders—
Sold by distributors everywhere

Fabrication of heavy welded structures is easy and reliable

Fast, uniform action in all positions

Spatter is at a minimum; slag curls off by itself

SW·15
COLOR IDENTIFICATION
Brown coating, plain tip, brown secondary
A.W.S. Class E6013

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Without obligation, send us your free "SMITHway Electrode Catalog."

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NEW PRODUCTS

The Society assumes no responsibility for the validity of claims in this section

NEW PORTABLE ACETYLENE GENERATOR

The new BURDOX Portable Acetylene Generator provides a new high for efficiency in the production of acetylene. All complicated operations are eliminated so that production is safe, simple and quick. Years of low-cost service are provided with a saving of up to 50% on acetylene.

This new BURDOX Portable Acetylene Generator is all steel welded and of simplified construction for dependable operation. It is designed on the principle of spring pressure opposed to gas pressure, and provides an even, steady flow of acetylene not to exceed 15 lb. pressure.

The three main parts of this generator are the Carbide Hopper, with its feeding mechanism; the Water Tank where carbide is fed from the hopper; and the Flashback Arrester through which acetylene flows to the service valve.

The generator hoppers use a "twist lock" method of mounting to the tank. For removal, the hopper is twisted and lifted off. It is designed so that it is impossible to refill hopper without removing it from the tank. This hopper removal permits cleaning of the feeding mechanism at each recharging operation. The tank valve plus the "easy action" agitator assure quick tank drainage.

Further information on this new Acetylene Generator is available from The Burdett Oxygen Co., 3328 Lakeside Avenue, Cleveland 14, Ohio.

ELECTRODE FOR STAINLESS STEEL WELDING

The extensive use of the stainless steels as heat resistant alloys has led to the development of many specialty steels; and A.I.S.I. type 312 (29-9) is an interesting example. This particular alloy is relatively new and is daily finding application in the welding of parts that must resist stress at elevated temperatures. This steel which has excellent high temperature corrosion resistance is also remarkably strong at high service temperatures.

As the designers of special high temperature steels wish to take advantage of joining by arc welding, the McKay Co. has developed, service tested and is now producing two new electrodes to meet these needs—McKay 29-9 and 29-9Mo. These electrodes not only deposit weld metal which meets the rigid specifications of fabricators of these super steels but they also feature easy, flexible operation in any position of welding.

The electrodes are available with either d.-c. or an a.-c.-d.-c. coating. The normal operating currents are slightly higher than those used with ordinary stainless steel electrodes. The following currents are recommended for either a.-c. or d.-c. welding:

Electrode Size, In.	Amperage Setting
1/8	95–120
5/32	145–170
3/16	190–215

Early attempts at making coated electrodes which would deposit 29-9 weld metal were unsatisfactory because of the tendency for the highly alloyed weld metal to crack or check. To correct this difficulty an extensive research program was carried out on heat resisting alloys and the metallurgical effects encountered during their arc welding. As a result of this investigation a proper balance of the alloying and coating elements has been found which allows the deposition of ductile, high strength, crack resistant weld metal. Typical test results of the weld metal show that as deposited it is of excellent quality, inclusion and porosity free, with a tensile strength of approximately 111,000 psi. and 35% elongation in 2 in.

A few of the applications of this electrode have been the welding of steam and gas turbine blades, and high temperature and high pressure pump parts.

The combination of the heat resistance and the high physical properties of the weld metal makes the electrode suitable for joining alloys that are approximately equivalent to the 29-9 type in composition and properties. There have been applications of the electrode based on the high strength of the weld deposit at normal temperatures. High strength plate is frequently welded with McKay 29-9.

Another application of the electrode is in the resurfacing of worn parts. One company has found that it pays to use this specialty electrode for resurfacing power shovel bucket lips because the heavily alloyed austenitic structure is highly work hardenable and results in increased life of the welded portion.

ARC WELDING MACHINE

Air Reduction Sales Co. announces the availability of the new Wilson "Wasp Special" air-cooled, engine-driven, arc-welding machine.

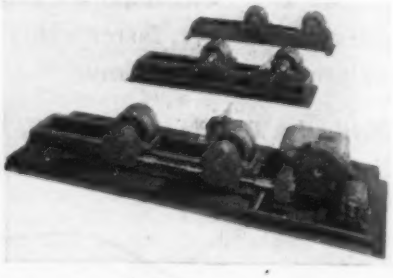
The "Wasp Special" is designed to furnish a smooth steady current and to stand up under usual and regular duty factor load conditions in tough construction and maintenance jobs in many varied applications.

This new 200-amp. arc welder has a welding range of 25 to 250 amp. at 30 v., 50% duty cycle. It is a light weight machine that is easy to handle and ideal for work in places inaccessible to larger and heavier equipment. Two convenient outlets are provided which may be used for lighting purposes or to operate universal power tools in an emergency.

Further information on the new Wilson "Wasp Special" arc welder can be obtained by writing directly tb Air Reduction Sales Co., Dept. A1777P, 60 E. 42nd St., New York 17, N. Y.

TURNING ROLL

Illustrated here is the New Model 120 Reed Turning Roll which has recently been announced by the Reed Engineering Co. of Carthage, Mo. This machine is used for rotating tanks and other cylindrical shapes for either manual or automatic welding and is also used as a tank positioner for work such as flame cutting, painting, etc. Consisting of one power unit with two synchronized driving wheels and one or more idler units, these rolls may be moved about the shop as desired and will handle work up to 12 ft. in diameter. The capacity for one power and one idler unit is 12,000 lb.; for one power and two idler units, 18,000 lb.



Standard equipment includes 3/4 hp. motor, dual rubber-tired wheels, all-steel base construction, anti-friction bearings and totally enclosed worm gear reduction drive. Variable speed drive gives any welding speed from 5 to 40 in. per min.

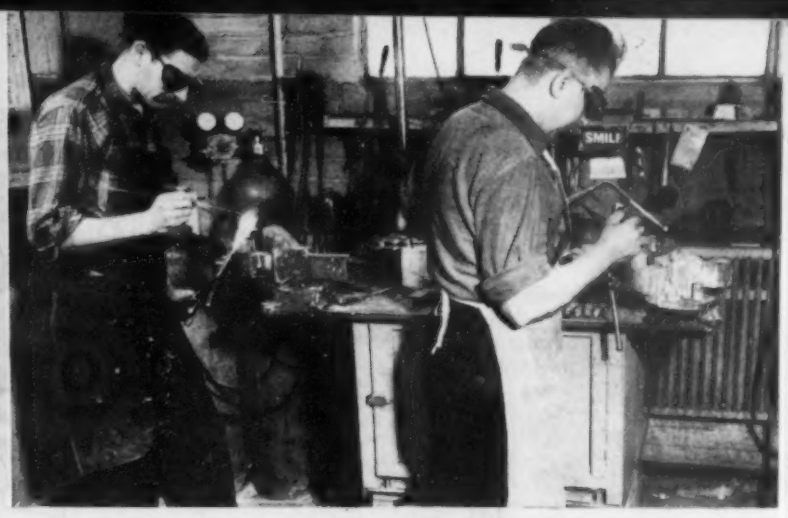
FLUTED WELDING ELECTRODES

Announcement has been made by P. R. Mallory & Co., Inc., Indianapolis, Ind., of an outstanding improvement in the design of resistance-welding electrodes which greatly increases the efficiency of this type of product.

This new and improved design, consisting of an internal fluting in the side of the water hole, provides better than 70% more water cooling area, materially increases the strength and rigidity of the electrode and provides automatic centering of the water cooling tube. These factors combine to materially increase the life of the electrode and quality of the weld produced, and eliminate distortion under pressure. Shop tests have shown life increases over the conventional electrodes of as much as 30%.

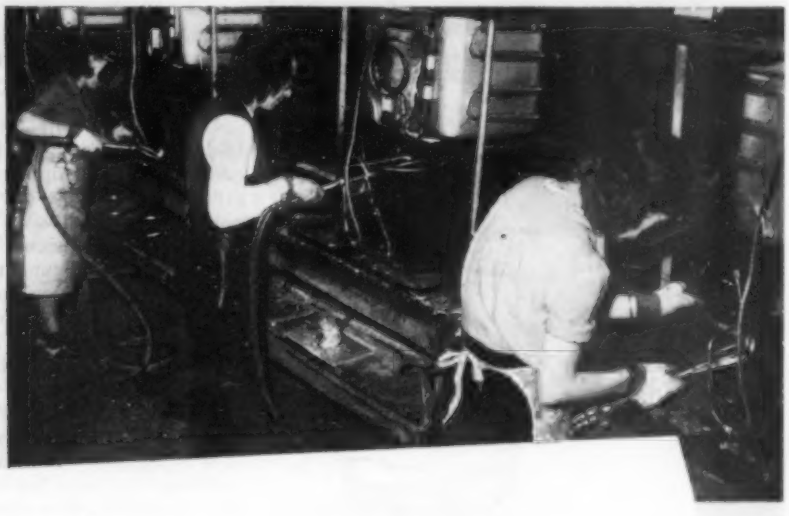
The Mallory fluted welding electrode

'special' welding bench is a very high speed production opera- and equipment takes a terrific beating—yet our Rego SX have performed perfectly during the eight years we have them," says Walter A. Kochanski, foreman of the sheet metal ment of Appleton Electric Co., Chicago, manufacturers of con- ings and lighting equipment.



"In our type of precision work a stable flame is imperative, and the combination of GX torches and RegOlators gives it. Further, Rego meets our need for a broad range of welding and brazing applications," says Mr. M. L. Higgins, President of Metro Tool and Gage Co., Chicago makers of carbide tools and dies and carbide and steel gages of all types.

"Since installation of Rego torches, regulators, etc. was made approximately 2½ years ago in our unit production plant, maintenance cost has been very low—in fact almost nothing", says J. R. Kirkendoll, Department Supervisor, of Rex Manufacturing Co. Inc., Connersville, Indiana, manufacturers of refrigerating cabinets.



Yes—accuracy and dependability have long marked Rego as superior apparatus for welding, cutting, heat-treating—wherever industrial gases are used. One reason Rego stands out for precision performance is the painstaking care that goes into every step of its modern manufacture. Another is that Rego is the expression of more than 30 years' experience in designing truly trustworthy oxy-acetylene apparatus. Yes—Rego is a pioneer line—foremost for quality.

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NCG

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RELY ON NCG

magnets. The permanent magnets are detachable and may be used for other purposes such as retrieving steel parts from dipping or plating tanks, collecting steel particles from grinder coolant tanks, etc. These magnets retain their strength for years.

Complete information and prices on the "Minute Man" Magnetic Welding Positioner may be obtained from The du Mont Corp., Greenfield, Mass.

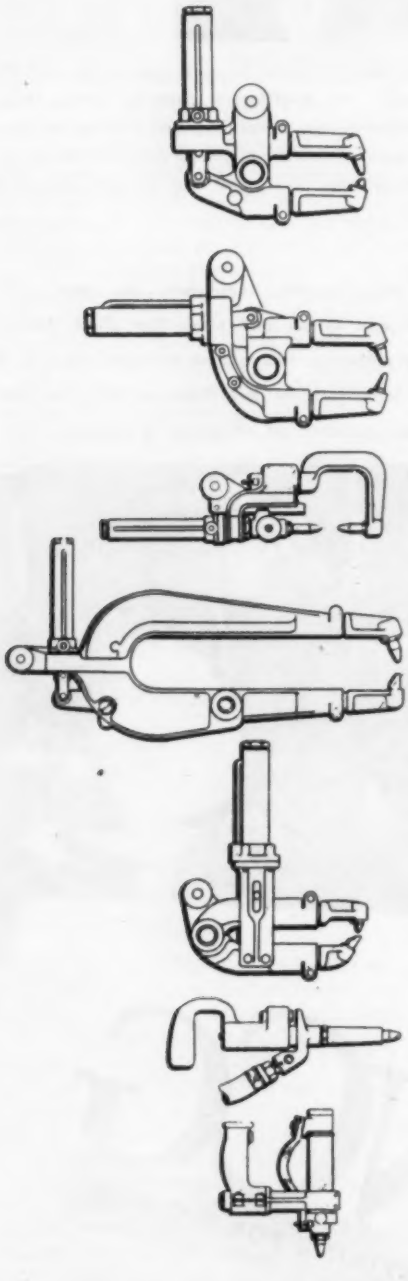


Fig. 1—Outline Sketches of the Seven Basic Standardized Gun Types

Reading, top to bottom, these are: scissors action, bell crank action, C-type direct action, deep throat rocker arm, clam action, push type (solid or spring loaded) and expansion gun (cable or cableless). All of the guns may be either hydraulic or air operated, except the deep throat type which is available only for hydraulic operation. Jaw extensions, cylinders, etc., are interchangeable between all gun types.

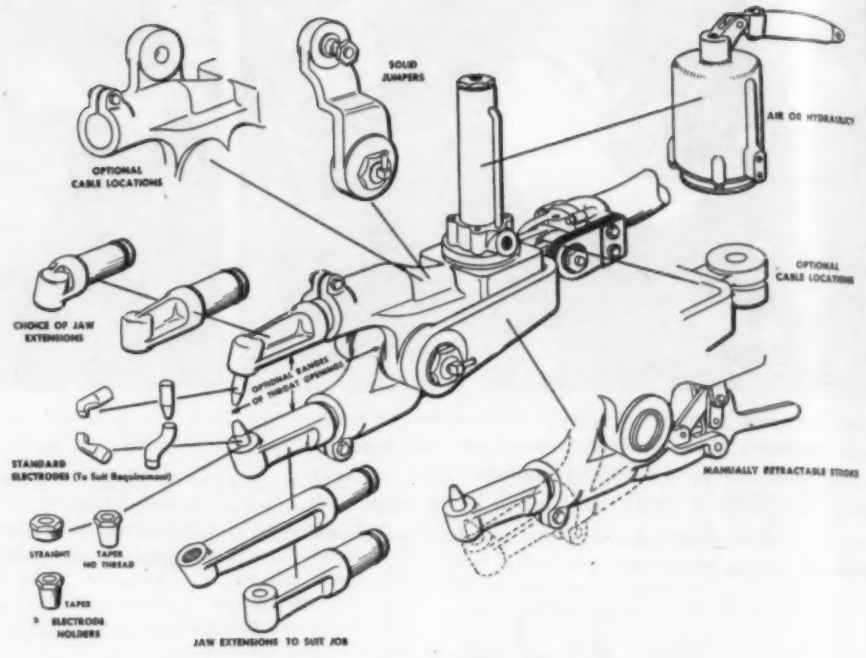


Fig. 2—Assembly Sketch of a Typical Gun Together with Typical Interchangeable Parts by Which the Design of the Gun and Its Use Can Be Varied

WELDING GUN LINE DESIGNED WITH STANDARDIZED INTERCHANGEABLE COMPONENTS

Industry's first line of really standardized spot-welding guns, designed with and constructed from interchangeable standardized component parts has been announced by Progressive Welder Co., 3050 E. Outer Drive, Detroit 12, Mich.

With this development, seven basic gun types, in heavy duty and standard duty versions, will take care of 95% of all gun-welding requirements. Moreover, a gun can be quickly converted to a different job by simply changing one or two standardized low-cost parts. This development thus provides an entirely new conception of welding gun versatility. However, at the same time there has been designed into these guns maximum handling ease on the part of the operator.

Basic standardized components of the welding guns are the gun chassis, the "jaw extensions," the interchangeable hydraulic or air operating cylinders, optional cable locations, handles, and "universal" cable terminal clamps, switches, electrodes and electrode holders.

With this standardization of component parts it is possible to obtain as many as 57,600 practical variations with a single basic gun chassis, while varying only the jaw extensions and standard electrodes. In addition to eliminating the cost and time of special gun designing for 95% of gun welding jobs, the new standardized line also insures quicker delivery through assembly from standardized stock components, maximum ease and lower cost

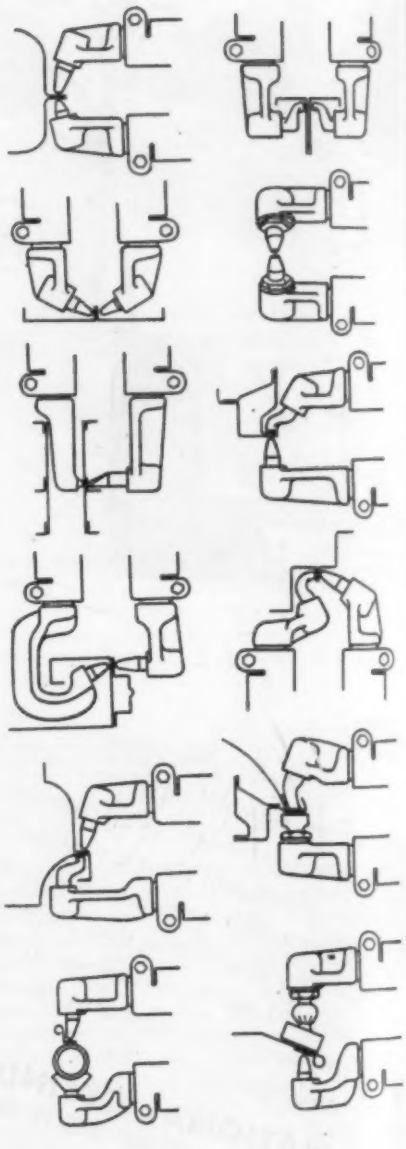
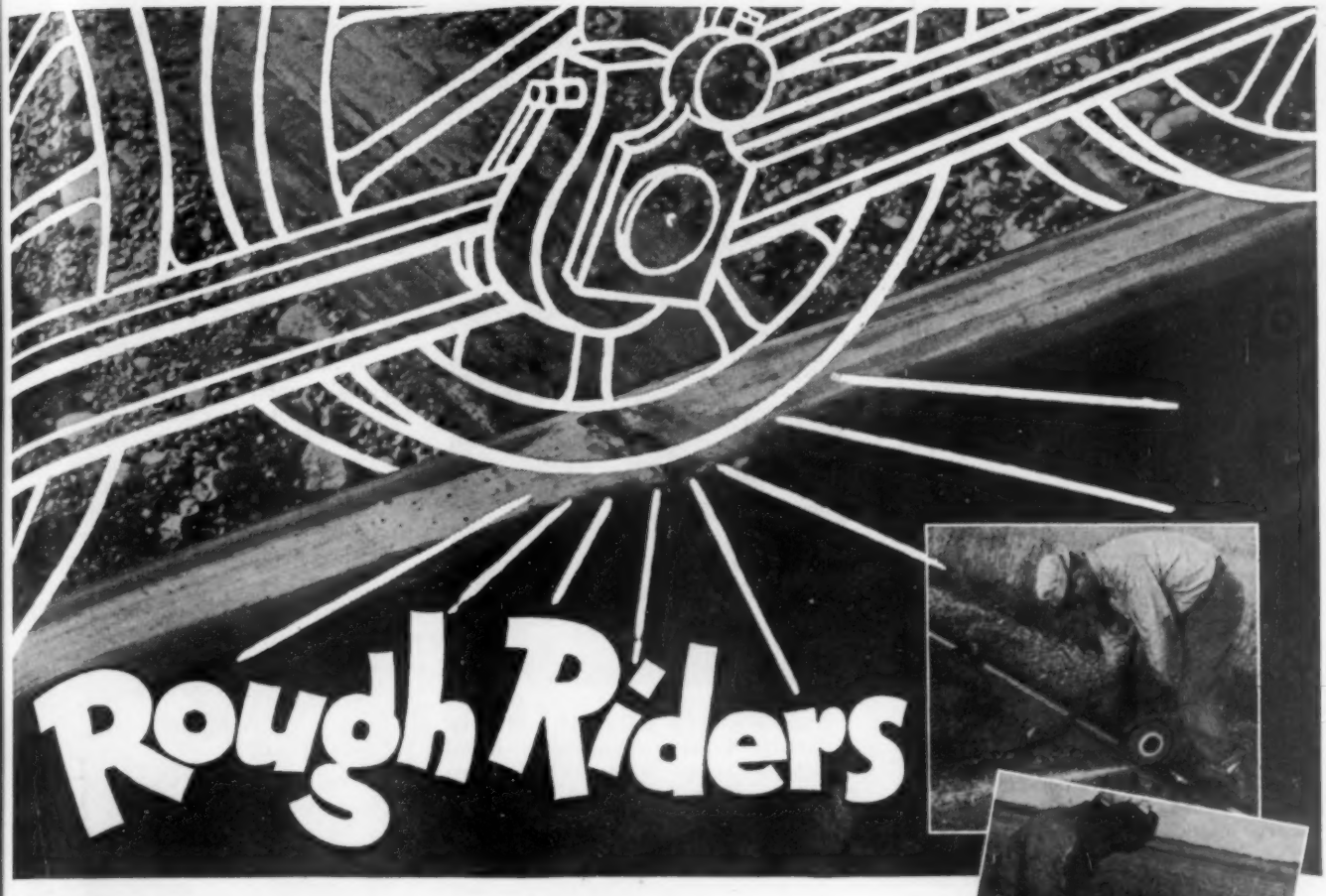


Fig. 3 (Right)—Group of Diagrammatic Sketches Showing Some Different Applications of the Same Gun Chassis When Equipped with Different Jaw Extensions and Electrodes



cured with Amsco Railface . . .

"Rough Riders"—that's an heroic term, in history books, but not when it's applied to the rails over which the passenger and freight trains roll across the country. Such worn and battered rail ends as are shown above can only mean passenger discomfort and unnecessary wear and tear on equipment. Amsco Railface electrodes are giving phenomenal results in keeping rail joints smooth for rider satisfaction and reduced equipment maintenance costs.

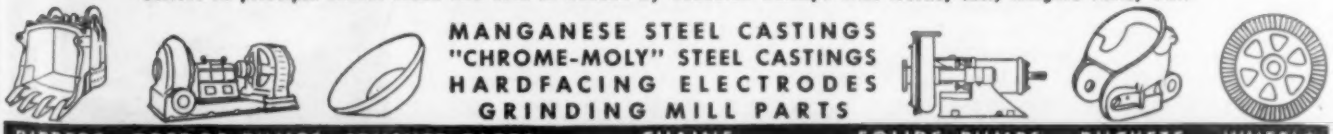
The small photographs show how the spalled or battered sections are ground, the welding operation, the joint after welding, and the completed weld after grinding ends to conform to balance of rail section. With an as-deposited Brinell of 325 to 350, work-hardening to 380 Brinell, this specialized electrode for high carbon content rail assures smooth joints that STAY SMOOTH.

This is another in the long line of Amsco Conservation Welding products that effect savings daily by reclaiming rebuilding, repairing, or hard-facing of parts subject to wear and service abuse. Complete details of all products are available in Bulletin 1047-W.

AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILL.

Foundries at Chicago Heights, Ill., New Castle, Del., Denver, Colo., Oakland, Calif., Los Angeles, Calif., St. Louis, Mo.
Offices in principal cities. Made and sold in Canada by Canadian Ramapo Iron Works, Inc., Niagara Falls, Ont.



MANGANESE STEEL CASTINGS
"CHROME-MOLY" STEEL CASTINGS
HARDFACING ELECTRODES
GRINDING MILL PARTS

DIPPERS DREDGE PUMPS CRUSHER PARTS CHAINS SOLIDS PUMPS BUCKETS WHEELS

service replacement of parts, lower inventories for large users since so many parts are interchangeable between guns; simpler gun maintenance; and reduced gun manufacturing costs, reflected in "more gun per dollar."

In addition to standardizing gun components, most of which are interchangeable between all guns of the new standard line, many of the other units—such as boosters, air valves and other subassemblies—comprising a complete gun installation have also been standardized.

Ingenious design of gun jaws enables guns to be provided with interchangeable jaw extensions to suit almost any requirement. The standard jaw extensions are available in 1-in. increments of length from 1 to 6 in. and with 4 (0, 10, 20 and 30°) variations for the angle at which electrodes are mounted. Chassis jaws are equipped with clamp-type locks, while jaw extensions have 0-ring type seals effectively preventing leakage. This has the additional advantage of making the jaw extensions adjustable in and out to compensate for electrode wear and maintain electrode alignment. It also permits rotating the jaw extension in the gun jaw to set electrodes at different angles to suit the job. Obviously also, short and long jaw extensions can be combined in the same gun, if desired, to meet certain requirements. The jaw extensions are completely interchangeable between different gun types of the new standard line. Standard electrode mounts having either plain taper sockets or threaded replaceable sockets, accommodating any R.W.M.A. standard electrodes.

This construction has made possible further basic improvements in welding gun design. Thus, cooling tubes are cast integrally in the gun chassis, eliminating chance of damage or leakage. Deflector tubes accurately fit the various standardized jaw extensions and are so shaped at their ends as to prevent blocking of water circulation.

NEW WELDER COMBINES D. C.-A. C. IN SINGLE UNIT

The inherent advantages of both d.-c. and a.-c. arc welding are offered in a single compact unit in the Kern Duel-Tronic Combination d.-c., a.-c. Welder. The arc is set for d.-c or a.-c. operation simply by setting two switches and a hand lever.

For d.-c. operation, the machine uses rugged rectifier tubes installed in a flexible mounting to supply direct current. Tubes are fully guaranteed for one year. The manufacturer states that idling losses are cut 50%, that power consumption under load is substantially decreased and that maintenance costs are reduced compared to conventional d.-c. motor-generator machines. The instant arc response eliminates surging and electrode spatter. The instant arc action is due to the absence of moving parts, which makes it unnecessary to overcome inertia or to neutralize armature reaction effects. Welds on light gage metals, including stainless steel, are uniformly good, as the accurately controlled low voltage eliminates excessive heating.

The arc is easy to strike and hold, even with electrodes as small as $^1/_{32}$ in. Metal as light as 32 gage can be welded successfully without burning through or appreciably altering the grain structure. Straight or reversed polarity electrodes may be used.

The easy striking and stable arc, combined with accurate amperage control, makes the d.-c. welder ideal for use on applications requiring the inert gas shielded arc-welding process.

The machine's a.-c. welding characteristics include smooth, instant starting and stable arc action and quiet, vibration-free operation. Inert gas shielded arc welding performance with a.-c. operation has been found excellent when a high-frequency current is introduced into the circuit.

A handwheel, mounted on top of the welder, provides accurate stepless amperage settings for a.-c. or d.-c. operation.

The Kern Dual-Tronic Combination D.-C.-A.-C. Welders and straight d.-c. welders are available with the following capacities:

Combination D. C.-A. C.	D.-C. Range	A.-C. Range
Model 20 DA	5 to 60 amp.	25 to 200 amp.
Model 25 DA	5 to 90 amp.	25 to 200 amp.

Straight D. C.	
Model 60 D	5 to 60 amp.
Model 90 D	5 to 90 amp.

Complete information may be had by writing John A. Kern Co., 224 N. Loomis St., Chicago 7, Ill.

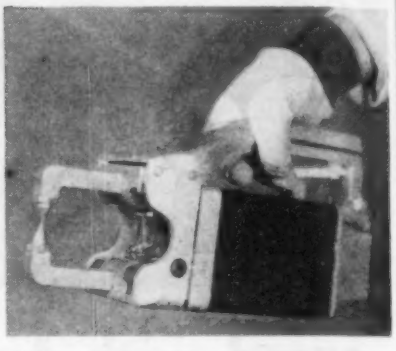
MAGNATIZED ANGLE LEVEL

Here is a combined level and angle that really sticks to the job. The Magno Level is perfect for any mechanic, but it is particularly useful to the plumber, steam fitter, welder or anyone who works with metal because powerful, permanent magnets will hold it to any flat or round metal surface. This leaves both hands free for lining up, straightening or fastening work in place. Accurately calibrated to show any angle from O to 360° the Magno Level is made of aluminum with handsome wrinkle finish and abuse-proof plastic dial.

Manufactured by The Buckeye Plastic Corp., 1220 Huron Road, Cleveland, Ohio.

PORTABLE SPOT WELDER

A new type of portable spot welder has been designed by the A-C-Devices Co., 8006 Champlin Ave., Chicago 19, Ill. This portable spot welder weighs only 22 lb. and is suitable for 110 or 220 v. alternating current. The welder is supplied with a 12-ft. extension cable, is completely portable and safe electrically. The unit can be taken to the job and does as good work as the stationary welder up to its capacity of



2.5 kw. With it may be welded mild steels, stainless steel, galvanized iron and aluminum up to $^3/_{16}$ in. Special tips, however, are required for welding aluminum. The unit is complete with $3^1/_2$ in. reach tongs and adjustable center point tips. Larger tongs are also available up to 18 in

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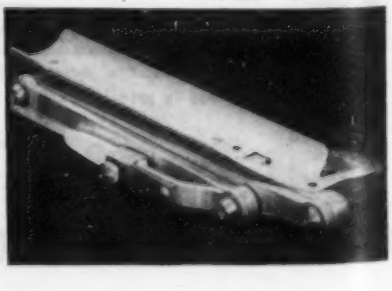
THE CONTOUR MARKER

The protractor, or dial, of the contour marker is graduated on both sides. On one side in degrees, on the opposite side in inches to the foot.

The manner of numbering nominally divides the protractor into two sectors. The sectors are marked A and B.

The sector marked A is for angles or slope measured from a perpendicular to the axis. The sector marked B is for angle or slope measured from the axis.

The frame or body of the contour marker consists of two channels in accurate alignment. Either side of the frame may be used and the side to select will depend upon the direction of the line to be scribed.



FOR SHIELDED ARC AUTOMATIC WELDING

THE NEW AND REVOLUTIONARY ELECTRODE FOR AUTOMATIC ARC WELDING

RACO Composite Type A is a heavily coated electrode in coils, providing the same physical results as heavily coated manual electrodes. With RACO Composite Type A, extremely high speeds can be obtained.

It can be used with all standard automatic arc welding heads with the addition of adapter and contact device illustrated.

RACO Composite Type A can be had with any of the following coatings—A.W.S. 6012; 6020; 6030; 7020; 7030, and corresponding high tensile grades A.W.S. 8020; 8030; 9020; 9030; 10020; 10030. This electrode can also be furnished in three grades of hard surfacing material for building-up—RACO 25 (20-25 Rockwell C), RACO 45 (40-50 Rockwell C) and RACO 55 (50-60 Rockwell C). RACO Composite Type A Electrode is furnished in the following sizes: No. 8 (approx. 3/8"), No. 7 (approx. 5/16"), No. 6 (approx. 1/4"), No. 5 (approx. 7/32"), No. 4 (approx. 3/16"), and No. 3 (approx. 5/32"). Coils are 36 inches I.D., and weigh 100 to 150 pounds net.

LIGHTLY COATED AUTOMATIC ELECTRODES:—

RACO Types "D", "M", M-9 (Knurled), Plain Mill Finish and Copper Coated Wire in coils.

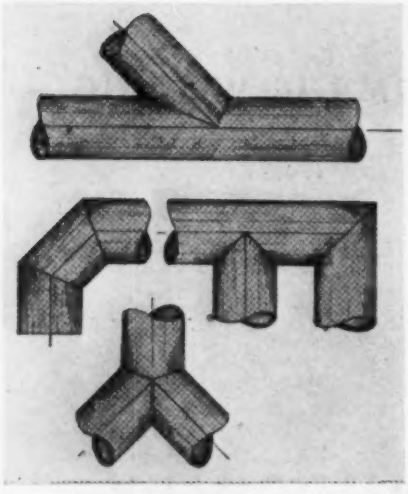
We draw a full line of copper coated oxy-acetylene welding wires. Furnished in coils and straightened and cut lengths.

We further manufacture a complete line of heavy coated manual electrodes for welding:—Mild Steel—High Tensile Steels—Stainless Steel—Manganese Steel—Cast Iron—Nickel—Monel—Inconel and Aluminized Steel.

Write for full information.

The REID-AVERY COMPANY
INCORPORATED
DUNDALK • BALTIMORE 22 • MARYLAND

SINCE 1919 PRODUCERS OF ARC WELDING ELECTRODES AND WELDING RODS



The center-pin through the dial is tubular and a V is cut at the opposite end of the frame so that the tool can be easily centered over a reference line. The reading aperature is also V'd at one end through which a reference line may be sighted.

Any one of the pipe jobs illustrated can be marked off (or layed out) in five minutes or less. The Contour Marker is the tool that will do it.

The new model is so neat and compact that you can fold it up and carry it in your hip pocket. And it's accurate too. It can be used on pipe from $1^1/_2$ up to 18 in.

A book of instructions is furnished with each tool. The instructions are very simple and easily understood.

Price complete, $19.95, F.O.B., Compton.

The Contour Marker Corp. of California, $1843^1/_2$ E. Compton Blvd., Compton, Calif.

SMALL WELDER

The Miller Electric Manufacturing Co. of Appleton, Wis., has announced a new low cost arc welder designed primarily for use by the "Hobbyist"—in the home or small workshop. It is definitely not a toy, but a real welder—it will actually deliver 100 amp.

This new unit, called the "Hobby Arc," available for either 110-v. or 220-v. a.-c. lines, operates on a standard 30-amp. fuse. It is ruggedly constructed with coils wound with glass-covered magnet wire, finest silicon steel cores and is set in an aluminum case for lighter weight.

The "dead front" construction and insulated transformer for safety, plus the ease of use and low cost, makes this an ideal unit for the novice or "some time" welder.

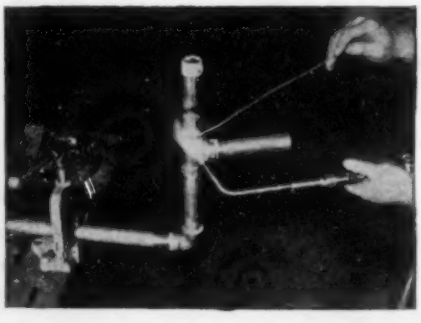
The welder is shipped complete with 10 ft. of welding cable with electrode holder, 10 ft. of ground cable, welding helmet and assorted welding electrodes. The 110-v. model has power cord and plug attached—the 220 v. model power cord only.

Illustrated literature on this model is now available.

THREADLESS BRONZE PIPE FITTINGS

Following the widely acclaimed introduction of Flagg-Flow, the first threadless malleable iron fitting, Stanley G. Flagg & Co., Inc., Philadelphia, has matched this development by applying the same principle in I.P.S. brass and copper pipe or tubing, with Flagg-Flow bronze fittings.

Flagg-Flow bronze fittings meet perfectly today's increasing demand for one-piece brass, copper pipe or copper tubing. They are threadless bronze pipe fittings for brazing to I.P.S. brass or copper base alloy tubing or pipe, and the one-piece system that results is as strong as the pipe itself, yet easy to install at low cost. The fittings are applicable for 150 lb. working steam pressure lines at 450° F., or 300 lb. non-shock cold water, oil, or gas lines.



With the same wall thickness and center-to-end dimensions as standard bronze fittings, Flagg-Flow can be used with thin-wall brass, copper pipe or tubing. The full strength of the pipe wall is utilized, since there is no loss of wall thickness by threading. With no threads to weaken the joint, the full depth of the socket of the fitting is brazed to the pipe. Interior design of the fitting tends to reduce turbulence, because the internal diameter of the fitting is the same as the internal diameter of the pipe or tubing. Close tolerances in the machining of the cups insure rigid support and a thorough bond.

Threadless bronze fittings, according to the manufacturer, can be used to great advantage in confined spaces where it is difficult to use a pipe wrench, or in locations inaccessible for maintenance after installation, and on lines subject to vibration, contraction or expansion. They are recommended for use in thin walls and partitions where ordinary, bulky fittings would be exposed, and in concrete or cinder-fill flooring where permanent security is essential, as in radiant heating.

Applications of Flagg-Flow bronze fittings range from domestic use on hot and cold water lines, steam piping, radiant heating, and fuel oil piping, to industrial use on meter and instrument lines, lubricating oil piping, gas and air piping, boiler feed lines, hydraulic systems of not over 300 lb, and in process piping where brass, copper pipe or tubing is applicable. Bronze threadless fittings can also be used in air, oil and water systems in the transportation field, especially where vibration and inaccessibility make screwed piping inadvisable.

Joining brass, copper pipe or tubing with Flagg-Flow bronze fittings is comparatively easy, and presents no problems in the brazing operation, where any capillary action alloy can be used. It is important, however, that all grease and dirt be removed from both the end of the pipe and the cup of the fitting. Emery paper should be used to polish the end of the pipe before applying the flux.

Additional information on the Flagg-Flow bronze fittings may be obtained from the Flagg Co., 1421 Chestnut St. Philadelphia 2.

ALL-PURPOSE FENDER DOLLY

A new metal working tool, known as the Matco Fender Dolly, has been announced by Modern Auto Tool Co., Inc. According to the manufacturer, this new device embodies all the conventional shapes and curves found in a set of ordinary fender repair tools and combines them into one compact low-cost tool that is said to be ideal for a wide range of fender, body and other metal straightening operations.

One of the features stressed by the maker, is a serrated facing on the tool which prevents the metal from stretching while being hammered out. This feature, it is claimed, is particularly valuable when working sheet aluminum and other light gage metals. The manufacturer also states that the serrated facing aids in removing paint, thus eliminating paint clogging of sanding disks when the sander is applied for finishing.

The tool has a specially designed hand grip which provides greater handling ease, lessens fatigue. Sturdily made of high-carbon tempered forging, it is said to be capable of withstanding years of rugged use.

Complete details may be obtained by writing to Modern Auto Tool Co., Inc., 6512 S. Ashland Ave., Chicago 36, Ill.

Employment Service Bulletin

POSITION VACANT

V-223. Wanted: Gas welding equipment sales engineer. Must have had experience with gas welding equipment design and sales. State education, experience and present salary.

SECTION ACTIVITIES

BRIDGEPORT

A Gala Party was held at the Housatonic Lodge in Stratford on Saturday, June 5th. A delicious Buffet Dinner was served, followed by dancing and entertainment. This was the last get-together this season and was thoroughly enjoyed by all.

CHICAGO

The closing meeting on May 19th of the 1947–48 season of the Chicago Section was devoted to Resistance Welding. The speaker was William J. Farrell, Assistant to the Vice-President of Sciaky Bros., who discussed "Three-Phase Balance Load Resistance Welding."

In his talk, which was illustrated with slides, Mr. Farrell explained the development of a resistance welding machine that converted three-phase power to single-phase power of lower frequency. He pointed out that this development resulted in a decreased kva. demand and an approximately balanced three-phase load on the power distribution system. While his company had pioneered this development, he acknowledged that there were other machines in the field designed to do the same job. In his slides he pictured many examples of products produced by this resistance welding process.

Prior to the meeting a movie entitled "Realm of the Wild" showing American birds and animals in our natural forests provided entertainment. After Mr. Farrell's talk there was considerable discussion of his subject, following which the new officers for the 1948-49 season were introduced. The meeting was brought to a close by the presentation of the past chairman's pin to C. O. Druetzler, retiring Chicago Section chairman.

The officers elected for the 1948–49 season are as follows:

Chairman, C. W. Steele, Steel Gases, Inc., Chicago; *1st Vice-Chairman*, W. C. Pearson, Westinghouse Electric Corp.; *2nd Vice-Chairman*, E. P. Auler, Taylor Forge and Pipe Works. Ted B. Jefferson was re-elected *Secretary and Treasurer* for the eighth consecutive year. Mr. Jefferson is with *The Welding Engineer*.

Directors (elected for three years): R. C. Cahoon, N. F. Bratkovich, T. Murr, and C. O. Watson. These Directors are in addition to the Directors now serving the Section.

CLEVELAND

Annual Symposium of the Cleveland Section was held on May 14th at the Hotel Cleveland.

The Symposium opened at 1:00 P.M. with registration, followed at 1:30 with an Exhibition of Good Welding Pertaining to the Cleveland Building Code. Russ Williams of the Lewis Welding & Engineering Co. was Chairman of Exhibits. At 1:45 a documentary motion picture entitled "Opportunity" The Story of the Best Location in the Nation, was shown through the courtesy of The Illuminating Co.

Fred L. Plummer of the Hammond Iron Works, was Chairman of the Afternoon Technical Conference. Technical speakers and their subjects were as follows: Lew Gilbert, The Champion Rivet Co., "Better Welding at Lower Cost"; Leonard C. Grimshaw, Jessop Steel Co., "Stainless Clad Plate and Sheet"; Paul W. Arnold, Reliance Electric & Engineering Co., "Welded Controls." A ten-minute supplementary discussion was presented by L. K. Stringham of The Lincoln Electric Co., on "Welded Controls Applied to Submerged Arc." A documentary motion picture on "Mineral Resources of Ohio" was shown by the Standard Oil Co.

The Evening Conference Program started off with Door Prizes and Dinner in the Ballroom. George N. Sieger, President of S.M.S. Corp., Detroit, was Toastmaster. The President of the SOCIETY, H. O. Hill, was also present. Speaker was Dr. Donald A. Laird, Ph.D., Sc.D., whose subject was "How to Get Along with Folks."

COLORADO

M. J. Conway, Application Engineer, General Electric Co., Schenectady, N. Y., was the guest speaker at the May 11th meeting held in Denver, Colo. Mr. Conway's subject was "Trends of Inert Arc Welding." A film "Arc Welding at Work" was also shown. This being the last meeting of the season it was decided to have a different type of meeting. General Electric Co. arranged to hold the meeting at their service shop, serving a Dutch Lunch at the close of the meeting. It was the largest in attendance and a very interesting meeting.

DAYTON

Annual Stag Party of the Dayton Section was held on Wednesday, May 26th, at McCrabb's Beechwood Grove. The program opened with a ball game at 4:00 P.M., followed by chicken dinner at 6:30; at 7:30 bingo and prizes and at 8:30 entertainment. A good time was had by all.

The following officers have been elected:

Chairman, B. A. Housfeld; *Vice-Chairman*, John Blankenbuehler; *Secretary*, William Taylor; *Treasurer*, George Theriault.

Directors: Howard Snyder, Fred Schulmeister, Clarence Schultheis, Earl Garber and Carl Smith.

HARTFORD

Dinner meeting was held on Thursday, May 20th, at the Whitlock manufacturing Co. Cafeteria, Elmwood, Conn. Short business meeting was followed by election of officers for the 1948–49 season as follows:

Chairman, S. Adelson; *Vice-Chairman*, J. K. Light; *Secretary*, J. W. Mortimer; *Treasurer*, F. J. Wallace; *Program Chairman*, L. D. Sykes; *Membership Chairman*, C. B. Culbert, Jr.

General discussion of welding problems followed the showing of a motion picture "Jet Propulsion."

LOUISVILLE

E. C. Brekelbaum, Chief Executive Engineer for the Harnischfeger Corp., Milwaukee, was the guest speaker at the May meeting held on the 25th in the Preston Kunz Restaurant. Mr. Brekelbaum spoke on the subject of "Co-ordination of Engineering and Production in the Manufacture of Welded Products." He discussed the progress of welding from a repair tool to a complicated manufacturing process. He explained that there are three steps in bringing about greater efficiency: the education of engineers in the fundamentals of welding in production, the adoption and proper use of adequate symbols and the coordination of engineering and production to be sure that the proper procedure is carried out. Lantern slides illustrated some of the tables of data that his company uses to accomplish these three steps.

After the talk and discussion period, a Dutch Lunch was served.

The next regular meeting of this Section will be held in September.

MICHIANA

The Michiana Section held their annual business and social meeting at the Isaak Walton League Club House, May 28th. Thirty-one were present and after receiving the annual reports they entered into a very lively discussion of various subjects such as how to make the meetings more interesting and how to use the Section's influence in getting better welding training in the public schools. Officers elected for the coming year were as follows:

Chairman, P. M. Perry; *Vice-Chairman*, Paul Barrett; *Secretary-Treasurer*, W. G. Fassnacht.

Executive Committee (new members): George Mittler Ralph Whittaker, and Frank Pryatel.

After the business meeting a bingo party with refreshments was held, and a good time was had by all.

NEW ORLEANS

The following officers were elected at the Annual Meeting held on Friday, May 14th, in Brunies Restaurant, Gretna, La.

Chairman, J. F. Houppert, Avondale Marine Ways, Inc., Harvey, La.; *Vice-Chairman*, J. H. Patterson, Esso Stand-

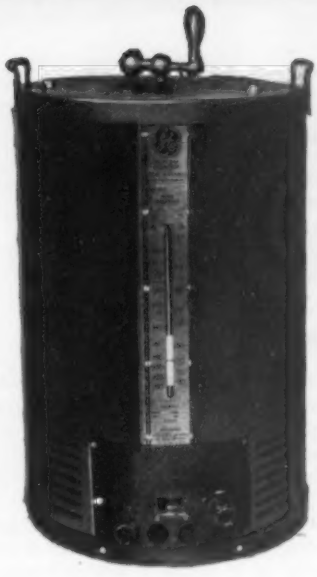
welding equipment means . . .

better easier lower-cost

ARC WELDING

HAVE YOU SEEN "ARC WELDING AT WORK"? It's a brand new, 30-minute, sound motion picture in color—major component of General Electric's new *More Power to America* program on Electric Arc Welding. The film and accompanying literature point out clearly the design and production advantages inherent in the three primary types of arc welding—metal-arc, Inert-Arc, and atomic-hydrogen. Your G-E Arc-welding Distributor will gladly arrange a showing for you; or write: *Apparatus Dept. General Electric Company, Schenectady 5 N. Y*

A-C WELDERS

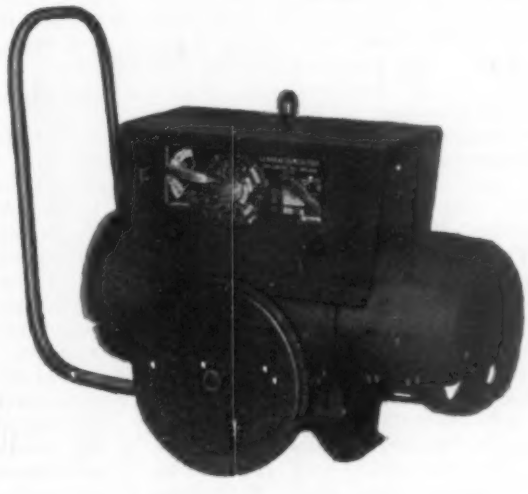


General Electric has long pioneered a-c welding—*the most advantageous method for 75 per cent of all welding applications.* G-E a-c welders (in 100- to 1000-amp ratings) include all the improvements you might expect from three decades of developmental experience . . . easier arc striking, better arc behavior, G.E.'s patented current-control system which permits unusually compact design; all these contribute to *more welding dollars in your pocket.* Ask your G-E Arc-welding Distributor for Bulletin GEA-4081A.

In addition to Inert-Arc welders, the G-E a-c welder family includes atomic-hydrogen welders for welding so-called "difficult" metals, and the new Type WP Inert-Arc welder for welding aluminum, magnesium, beryllium copper, etc., without flux and without radio interference. Bulletins GEA-823 and GEA-4930 respectively.

D-C WELDERS

Here is your G-E answer to those applications for which d-c is recognizedly preferable—the recently announced WD-40 series d-c welders. Snappy, stable arc and higher welding efficiency . . . single-dial dual control for both precision and flexibility . . . 50% savings in size and weight . . . dependable low-cost service, easy maintenance, and a long "life-span"—all these outstanding features have been incorporated into these new machines by modern, *functional* design for *better* d-c welding. Available in 200-, 300-, and 400-amp ratings; you'll find the complete story in Bulletin GEA-4852, from your G-E Arc-welding Distributor.



ALL of the welding performance . . .
None of the "Dead-weight"

AUTOMATIC EQUIPMENT—Along with a-c or d-c welders as the source of welding current, G.E. can supply complete machine-welding equipment, including automatic welding heads, control panels, travel carriages and work-moving mechanisms, electrodes, and accessories. Bulletin GEC-244.

ELECTRODES AND ACCESSORIES—63 types of G-E welding electrodes can help provide the answer for welding mild steel, cast iron, stainless steel, phosphor bronze—general-purpose welding, and alloy and special-purpose welding. G-E welding accessories, described in catalog GEA-2704, are designed for easier welding with maximum protection.

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"A-C or D-C . . .
there's G-E Arc-welding Equipment for Every Application!"

ARC WELDERS • ELECTRODES • ACCESSORIES

GENERAL ELECTRIC

ard Oil Co., Baton Rouge, La.; *Secretary*, Donald Sarrat, Gulf Welding Equipment Co., New Orleans, La.; *Treasurer*, R. P. Wilson, The Linde Air Products Co., New Orleans; *Program Chairman*, James W. Chambers, Esso Standard Oil Co., Baton Rouge, La.

Membership Committee: C. O. Stilwell, J. B. Bert and E. H. Elbourne.

NEW YORK

The New York Section held its Annual Smoker on May 7th at the Building Trades Employers Club. Over 300 members and guests attended the affair. The Committee in charge of the arrangements were G. Schneider, H. R. Morrison, E. H. Roper, L. F. Granger, S. Walter, M. J. Giraldi, J. L. Cahill, E. Vom Steeg, C. Kandel, E. B. Stolle, J. Kneiper and A. M. Setapen.

Announcement was made of the officers for the 1948–49 season as follows:

Chairman, E. H. Roper, Air Reduction Sales Co., N. Y.; *1st Vice-Chairman*, J. L. Cahill, New York Navy Yard, Brooklyn; *2nd Vice-Chairman*, H. W. Lawson, H. K. Ferguson Co., N. Y.; *Secretary-Treasurer*, L. F. Granger, The Linde Air Products Co., N. Y.

Members-at-Large: (one-year term), A. E. Poole, The Hallen Co., Inc., Long Island City; (two-year term), J. K. Anderson, War Assets Administration, N. Y.; (three-year term), H. R. Clauser, Materials & Methods, N. Y.; N. John Rees, Socony-Vacuum Oil Co., N. Y.; W. E. G. Lucas, Taylor Forge & Pipe Works, N. Y.; M. J. Giraldi, American Bureau of Shipping, N. Y.

Nearly 200 members of the New York and Bethlehem, Pa. Sections were guests of the Air Reduction Sales Co. at their new laboratory in Murray Hill, N. J., on Saturday, May 22nd. Attendants at the inspection trip were given a conducted tour of the new laboratory building and were then left free to visit the operating exhibits in which they were most interested. These exhibits included shape-cutting, manual and mechanized inert-gas-shielded arc welding, the stick-feed welder, and I-beam cut-off machine, manual scarfing, and flux-injection cutting. A special live demonstration of cutting steel at elevated temperatures was held just preceding the lunch period.

Those attending the inspection trip were guests of the company for lunch in the laboratory cafeteria. Charles Kandel, member of the Executive Committee of the New York Section, was in charge of arrangements in behalf of the Section, and H. O. Klinke, a past-chairman of the Section, handled the arrangements for Air Reduction Sales Co. The inspection trip was arranged through the courtesy of George S. Mikhalapov, Director of the Laboratory.

NORTHERN NEW YORK

Annual Meeting of the Northern New York Section was held on May 27th at the Holland Inn, Schenectady.

Technical Activities meeting was held on May 11th at Ferro's Restaurant, Schenectady.

OKLAHOMA CITY

The Oklahoma City Section held its last business meeting of the season on Wednesday night, May 5th, at Jack Barnes Club Room. Everyone present very much enjoyed the speaker of the evening, P. J. Patton of the Ransome Machinery Co. Mr. Patton spoke on the subject of "Positioning for Welding." His talk was very well given. Mr. Patton has an unusually fine ability to tell a good story and get a laugh and he used a few slides after his formal talk was over. Refreshments were served after the meeting. These were so well received by the group that it was decided to make this a regular after-meeting item.

The following officers have been elected for the new season:

Chairman, L. D. Robson; *Vice-Chairman*, Ed Hotchkiss; *Executive Vice-Chairman*, Wm. Klein; *Secretary*, R. J. Trautman; *Treasurer*, W. D. Brewer.

Executive Committee (two-year period L. P. Stilwell, E. B. Reeves, Leon L. Lowrey, Jerry Fiegener; (one-year period) Otto Hart, C. L. Bullock.

PHILADELPHIA

At the regular monthly meeting held on Monday, April 19th, at the Engineers' Club, the subject "The Development and Testing of the H-Section Welded Truss" was presented by H. A. Anderson, Vice-President and Manager, Eastern District, The Austin Co., Cleveland, Ohio.

The Juniors of the Engineers' Club of Philadelphia held on May 11th to 16th the Second Engineering Progress Show in the Franklin Institute. The theme of the Show is indicated by its title. Its purpose is to pay tribute to the nation's Engineering progress by displaying the latest achievements in the industrial and scientific fields. Organizations from all the branches of engineering were represented at the show.

In the evenings, E. G. Bailey, National President of the American Society of Mechanical Engineers, Vice-President of Babcock Wilcox and founder of the Bailey Meter Co., and T. P. Simpson, Director of Research and Development at the Socony-Vacuum Corp., and many other nationally prominent engineers, spoke on subjects of definite interest to the engineering profession.

The May meeting was held on the 17th at the Engineers' Club. After-dinner speaker was Harry W. Pierce, Assistant to President, New York Shipbuilding Corp. Mr. Pierce spent four months in Japan with Overseas Consultants, Inc., and spoke of his experiences in Japan.

The technical speaker was H. T. Herbst, Development Engineer, The Linde Air Products Co., whose subject was "Theory and Production Applications of Inert Gas Shielded Arc Welding."

PITTSBURGH

The photograph herewith was taken at the Eleventh Annual Tri-State Welding Conference held on Friday, April 30th. A complete account of this Conference was given in the June issue of THE WELDING JOURNAL.

The May 19th meeting was held at Mellon Institute. Dinner at Webster Hall Hotel preceded the meeting. C. N. Clark and H. B. Wood, Duquesne Light Co., discussed Utility Problems in Supplying Power for Arc and Resistance Welders. A motion picture film "Story of A.-C. Welding" was also shown.

The following officers have been elected for the fiscal year starting in April:

Chairman, H. P. Schane; *1st Vice-Chairman*, T. W. Morgan; *Secretary*, J. F. Minnotte.

Executive Committee: E. H. Turnock, G. J. Green, Milton Male, John E. Mason, W. H. Kauffman, L. R. Nourie.

PORTLAND

The following officers were elected for the fiscal year 1948–49 at the May 11th meeting:

Chairman, J. H. Crumley, King Bros., Inc., Portland, Ore.; *Vice-Chairman*, John Bristow, King Bros., Inc., Portland; *Secretary*, Wilbur C. Smith, Industrial Specialties Co., Portland; *Treasurer*, Charles J. Daniels, American Pipe & Construction Co., Portland.

Directors (for two years): Lee Place, H. A. Sanner, Malcolm Westover.

PUGET SOUND

The May Meeting of the Puget Sound Section was held at the Engineers' Club on Wednesday the 12th. The speaker was L. M. Crawford, Licensed Welding Engineer for the Boeing Aircraft Co. His subject was, "The Welding of Aluminum Alloys." All types of welding were covered, such as oxyacetylene and oxy-hydrogen torch welding, inert gas welding, resistance welding, soldering and brazing. Several samples of different types of welding on several aircraft parts were shown.

A color sound film presented by the Air Reduction Co. on Oxyacetylene Cutting was shown. This film covered the history of oxyacetylene cutting from its

Pittsburgh Eleventh Annual Tri-State Welding Conference. Left to Right.—T. W. Morgan, G. D. Hoglund, T. D. Jolly, H. O. Hill, H. P. Schane, Clarence W. Head, L. J. Reed, Leon C. Bibber, G. S. Mikhalapov

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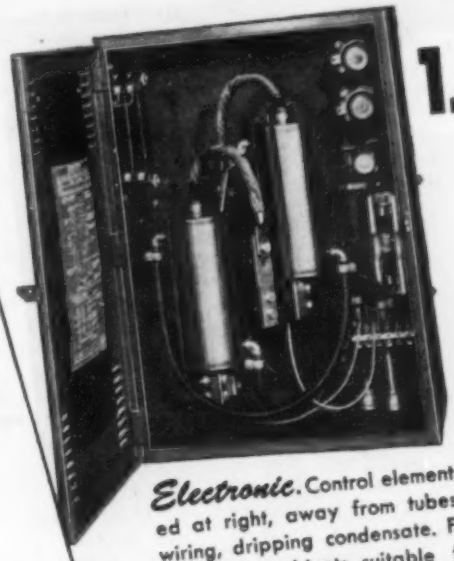

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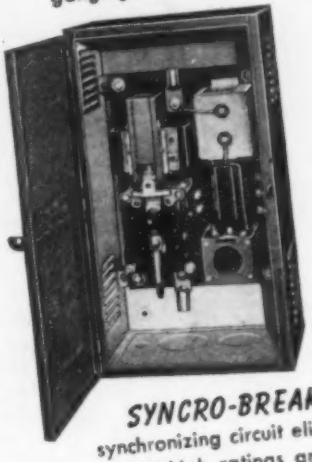
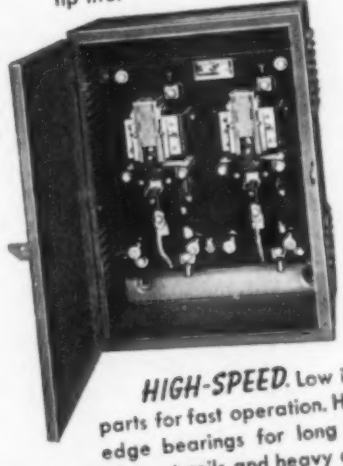
Electronic. Control elements grouped at right, away from tubes, power wiring, dripping condensate. Flat door, ventilated cabinets suitable for close ganging. Generous wiring space.



2

SYNCRO-BREAK. Easily adjusted synchronizing circuit eliminates arcing to permit high ratings and longer contact tip life.



3

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Electronic contactors for jobs involving heat control, very short weld periods at heavy currents, or exceptionally high speed operation.

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early beginning to the present time. All types of cutting machines were shown in operation on various types of fabricating jobs.

This was the final meeting of the year and the officers for the next year were elected as follows:

Chairman, C. M. Styer, Pacific Car & Foundry, Seattle, Wash.; *Vice-Chairman*, Elmert E. Gunnette, American Institute of Steel Construction, Seattle; *Secretary-Treasurer*, Theodore Axtell, National Cylinder Gas Co., Seattle.

ST. LOUIS

A general discussion on the mechanical and physical properties of nickel, Monel and Inconel, was presented by R. M. Wilson, Jr., in a talk entitled, "The Welding of Nickel and High Nickel Alloys," before the St. Louis Section on Friday evening, May 14th, at the Forest Park Hotel. Mr. Wilson is a member of the Technical Service Section of the Development and Research Division of The International Nickel Co., Inc., at New York.

SAN FRANCISCO

Annual Ole Timers and Past Chairmen Night was held on May 24th at the Engineers' Club. Dinner preceded the meeting. Once each year the San Francisco Section honors its "Ole Timers" who founded and developed the Section 26 years ago.

Richard C. Wiley of the California State Polytechnic College, gave a talk on "Training Welding Technicians on a College Level." This subject was particularly timely in view of the existing controversy over proposed codes.

SOUTH TEXAS

The South Texas Section announces the election of officers for the fiscal year starting June 1948.

Chairman, A. E. Wisler; *1st Vice-Chairman*, Frank Neal Jr.; *Secretary-Treasurer*, Chas. Haas.

Executive Committee: L. H. Courtright, W. T. Hudson, Ben Allen, K. E. Luger, G. C. Steffen, W. C. Cox, Joe Dahl, W. R. White, E. H. Bruckmiller, S. R. Demecs, H. V. Mosby, W. T. Hickman.

SYRACUSE

The Syracuse Section held its Fifth Annual Meeting with a dinner at the Hotel Syracuse, Wednesday, May 19th. An entertaining program was enjoyed by 160 members and wives. "Jim" Swan, an accomplished entertainer really "let his hair down" in giving the true experiences of a Marine in a humorous skit based on his adventures in the Pacific.

The results of the annual election were reported by R. J. Greer of Welding Engineering Sales Co., as follows:

Chairman, H. E. Miller, Carrier Corp.; *Vice-Chairman*, W. Burkhardt, Air Reduction Sales Co.; *Secretary*, E. L. Smith, Lincoln Electric Co.; *Treasurer*, M. R. Ames, Carrier Corp.

Directors (for two years): E. M. Fisher, J. Solar, H. Wolfe, J. H. Hunter, L. C. West, Kenneth Clark, H. C. Keller.

Short reports were given by the Past Chairman, J. T. Hotchkiss of Bentley Weldery, the Secretary, E. L. Smith of Lincoln Electric, and the Treasurer, W. L. Burkhardt of Air Reduction. These included eight top-notch meeting programs substantial gains in membership and a favorable financial balance.

E. M. Fisher of the Utica Steam Engine Co. was a very able toastmaster presenting past-chairman pins to A. M. D. Cassel and J. T. Hotchkiss. He also supervised the drawing for an extensive array of door prizes.

TOLEDO

The Toledo Section closed its 1947–48 season with what might be termed a good pep shot in the arm.

By arrangement of the Program Committee the regular annual technical meeting was by-passed and instead a purely social "dinner-get-together" was held on May 5th.

E. V. Newman, chairman elect for a second term, acted as toastmaster. He pointed out that the Program Committee had already given considerable thought to the "doings" for next season, which would include a few plant trips and some other specialties to make things interesting.

An excellent steak dinner was served at 7:00 P.M. after a "fresh-up" hour at the Northwood Inn in Toledo, to 14 members and 9 guests.

Genial property man, Henry Menna, then got busy turning out lights with the help of one of the comely members of the opposite sex, who was in attendance while dinner was served, in preparation for coming events.

For about an hour three most interesting and exciting films were shown. They were "Realm of the Wild," "Atlantic Salmon" and "Fishing Thrills."

Concluding the evening some of the boys relaxed in a corner talking over their big problems, while others pitted their skill in poker against fickle lady luck. Barrels were furnished to some later on by the management of the Northwood Inn to ward off the cool evening breeze.

A good time apparently was had by all. Lights went out at 11:00 P.M. and so ended the 1947–48 Season, with a good promise to be better next year.

TRI-STATE

At an organization meeting held on Friday, May 7th, in Evansville, Indiana headquarters the following officers were elected for the newly formed Tri-State Section.

Chairman, Joseph B. Feuquay, Seeger Refrigerator Co., Evansville, Ind.; *1st Vice-Chairman*, William B. Blackburn, International Harvester Co., Evansville; *2nd Vice-Chairman*, W. A. Brackett, Seeger Refrigerator Co., Evansville; *Secretary*, Dana S. Cope, Servel Inc., Evansville; *Treasurer*, E. E. Cashen, Evansville, Ind.

WICHITA

The final meeting of the season was held on Monday, May 10th, with a "Stump the Experts" program.

Questions on the following welding processes were very ably answered by the list of experts given below: arc welding, oxyacetylene welding, resistance welding, metallurgy, special processes, equipment maintenance and operation.

Experts: Harry Moberly, the Coleman Co.; Phil Koerner, Beech Aircraft Corp.; Harvey Bates, Socony-Vacuum Oil Co.; R. R. Kirkland, Cardwell Mfg. Co.; Earl Krasser, Boeing Airplane Co.; Lee Ormsbee, Watkins, Inc.; John Wiley, Tweco Products Co.; Delbert Hughes, Air Reduction Sales Co.

Officers for the 1948–49 season were announced as follows:

Chairman, S. G. Browne, B & G Boiler and Supply Co.; *Vice-Chairman*, H. W. Beeman, Tweco Products Co.; *Secretary*, G. Mitchell Allen, Lampton Welding Supply Co.; *Treasurer*, Ben Carpenter, Davis Mfg. Co.

CANADIAN

Niagara District Chapter of the Canadian Welding Society held its final meeting on Wednesday, May 12th. "Arc Welding at Work" was the subject presented by Fred J. Butters, Welding Specialist, Canadian General Electric Co. Ltd., Hamilton.

The Montreal Chapter held its Eighth Meeting of the Season on Wednesday, May 26th. "Magnaflux and Zyglo Inspection of Welds" was presented by Hamilton Migel, Assistant Vice-President and Eastern Manager, Magnaflux Corp.

ABSTRACTS OF CURRENT WELDING PATENTS

Prepared by L. V. Oldham

Printed copies of patents may be obtained for 25¢ from the Commissioner of patents, Washington 10, D.C.

2,440,247—WELDING SYSTEM—John W. Dawson, inventor, Auburndale, Mass., assignor to Raytheon Mfg. Co., Newton, Mass. (11 Claims)

A somewhat complicated electric control system for a welding circuit is disclosed and covered in the patent. The control system includes a transformer

having an input winding with two supply terminals and an intermediate terminal, and an output winding. Cathode means of an electronic valve connect to the intermediate terminal and anode means connect in series with the source terminals. The circuit includes several other elements including a control electrode means that connects to a point of a portioning means that are provided between the intermediate terminal and one of the supply terminals.

2,440,298—METHOD OF BRAZING STEEL SHAFT AND FLANGE ASSEMBLIES—Bela Ronay and Cyril D. Jensen, inventors, Annapolis, Md. (8 Claims)

The method disclosed in this patent relates to the assembly of male and female shaft elements wherein members having a closely interfitting zone are to be secured together. One cavity for reception of a brazing material is provided in one member and a flux is supplied to the surface of one of the members in the brazing zone. The brazing material is heated to cause it to flow into the clearance zone when radially compressive pressure is exerted by the female element onto the male element at the brazing zone.

2,440,463—SPOT WELD TIP WITH REPLACEABLE INSERT—Leo W. Cornwall, inventor, San Diego, Calif. (5 Claims)

Cornwall's structure comprises a hollow tubular spot weld tip which is provided with a replaceable insert having a welding contact at one end and a specially contoured portion at its other end which is adapted to be wedged into the end of the spot weld tip.

2,440,527—ACETYLENE TORCH CUTTER SUPPORT—Hyrum M. Talley, inventor, Alhambra, Calif., assignor to American Pipe & Steel Corp., Alhambra, Calif. (4 Claims)

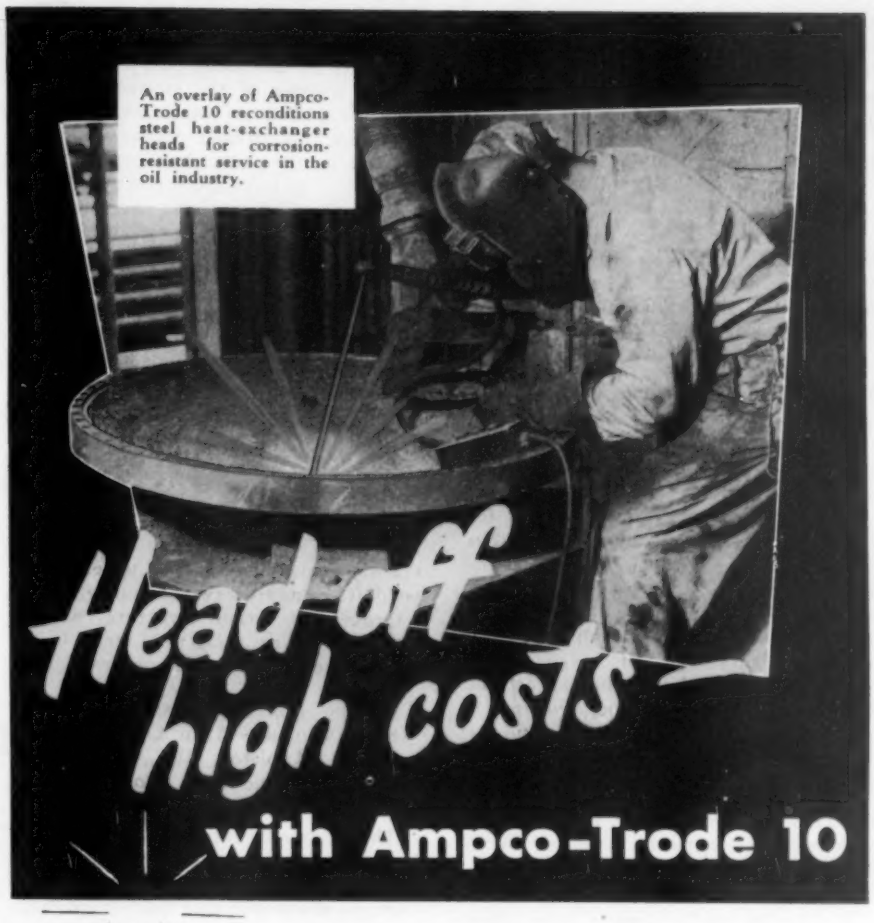
This novel construction covers a support for the forearm of a torch cutter operator and the support is rollably supported in such a manner that the support may ride a right-angled edge of a plate to be beveled without the edge contacting the underside of the support.

2,440,596—WELDER'S HELMET—Marshall N. Anderson, inventor, Chicago, Ill., assignor to Sellstrom Mfg. Co., Chicago, Ill. (7 Claims)

Anderson's welder's helmet has a head band and an eye shield pivotally carried by the head band and movable from eye shielding position to a position above the eyes. A face mask is also provided and is coupled to the eye shield so that the eye shield is brought into operative position when the face mask is raised and the eye shield is moved to a position above the eyes when the face mask is operatively positioned.

2,440,696-7-8—WELDING MECHANISM, ETC.—James M. Patterson, inventor Jennings, Mo., assignor to Central Mine Equipment Co., St. Louis, Mo. (11, 3 and 9 Claims, respectively)

These three patents issued to Mr. Patterson relate to a special welding device for welding a cylindrical element to a spiral flight. The welding mechanism


An overlay of Ampco-Trode 10 reconditions steel heat-exchanger heads for corrosion-resistant service in the oil industry.
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with Ampco-Trode 10

—avoid frequent replacements by using durable corrosion-and erosion-resistant overlays

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You, too, can save time and money with Ampco-Trode 10! Use it to weld dissimilar metals—for bearing surfaces where hardness and friction resistance are important—for process equipment where corrosion-resistance is essential. See your nearest Ampco distributor today for a supply of these money-saving electrodes. Write for bulletins giving complete information.

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engages the spiral flight for controlling travel of the welding mechanism in accordance with the rotation of the spiral flight.

2,440,816—Air-Cooled Electrode Holder—Louis D. Abramson, inventor, Boston, Mass. (1 Claim)

This electrode holder has a tubular handle with clamp jaws provided therein for engagement with a welding rod. A perforated sleeve encircles the clamp jaws in spaced relation thereto to permit air circulation therearound.

2,440,892—Capacitor Discharge Welding System—Edwin M. Callender, inventor, Philadelphia, Pa., assignor to The Budd Co., Philadelphia, Pa. (3 Claims)

The welding system of this patent includes an electric power source and a capacitor with a load circuit being connected thereto. A single charge-discharge sequence is set up in the system by means of a time-delay relay and switch contacts in both the charge and discharge circuit operated by the relay. The charge and discharge contacts are operated in sequence in one operation of the relay and the relay is energized only by a flow of current from the power source.

2,440,941—Arc-Welding Electrode—Francis E. Garriott, inventor, West Allis, Wis., assignor to Ampco Metal, Inc., Milwaukee, Wis. (17 Claims)

A covering for a copper base alloy electrode is covered in the patent. This material comprises fluoride slag producing ingredients and a binder. The ingredients of the covering material are proportioned to provide a cover having a load disintegration temperature correlated to the melting point of the metallic core of the electrode.

2,441,043—Spot-Welding Machine—Bernard Stoudt, inventor, Valley Stream, N. Y., assignor to Ames Spot Welder Co., Inc., Brooklyn, N. Y. (3 Claims)

Stoudt's patent covers, in a relatively limited manner, the controls for a spot-welding machine so as to regulate the spot weld arms in a desired manner.

2,441,176—Method of Fusion Welding Involving Use of Initial Layer of Finely Divided Metal—Evan F. Wilson, Akron, and John C. Grubb and Floyd A. Fowler, Barberton, Ohio, inventors, assignors to The Babcock & Wilcox Co., Jersey City, N. J. (5 Claims)

This patent relates to a butt-welding process for joining the ends of ferrous metal plates by metal fused within a welding groove defined by and completely separating the ends of the plates. The groove is backed with a nonmetallic, nonslag-forming material and substantially pure ferrous metal powder is applied to the interior of the groove. Welding heat is applied to the upper surface of the layer; additional molten metal is applied to the metal between the plate ends so as to form a layer of weld metal joining the plate ends at the lowermost portion of the welding groove. Additional weld metal is fusion-deposited within the groove to unite with the initially formed layer of weld metal.

2,441,257—Welding Stud—Albert M. Candy, inventor, LaGrange, Ill., assignor to National Cylinder Gas Co., Chicago, Ill. (6 Claims)

The welding stud of this patent has a rivet-shaped piece of metal held against one end of the metal stud. The rivet-shaped member is formed from such material in a proper amount to unite with the metal made molten by the heat of the weld arc so as to scavenge and refine and improve the grain structure without rendering the resulting weld metal brittle at the junction of the stud and workpiece.

2,441,438—Portable Manual Electric Spot Welder—Allen C. Mulder, inventor, Appleton, Wis., assignor to Miller Electric Mfg. Co., Appleton, Wis. (7 Claims)

This manually operated spot welder includes a body made up from a plurality of laminations forming the core of a transformer and a pair of spot welding tongs are carried by one of the hollow end caps provided for the transformer. A primary coil is positioned in the core and a secondary turn thereadjacent provides a transformer which is connected through one of the end caps and the terminals of the secondary turn with the welding tongs also being connected to such circuit. One of the welding tongs is pivotally associated with the apparatus and a control lever is provided to move the pivoted welding tong to and from welding position.

2,441,507—Apparatus for Arc Welding—Vladimir Peters, inventor, Lakewood, Ohio, assignor to The Lincoln Electric Co., Cleveland, Ohio. (10 Claims)

The arc welding of angularly related workpieces is performed by this apparatus which includes a support having a weld rod guiding device pivotally attached thereto. The weld rod guiding device is rotatably adjustable about a substantially vertical axis.

2,441,551—Welding Tool—Robert E. Anderson, inventor, Champaign, Ill. (1 Claim)

Anderson's welding tool covers the combination of a tubular main rod with a welding torch. A feed wheel is supported by the main rod for feeding a welding rod guided within the main rod and a carbon holder is supported by the main rod with the carbon holder being adjustable with respect to the welding rod.

2,441,589—Welding Rod Holder—Frank Nichols, inventor, Pensacola, Fla. (1 Claim)

The novelty of this rod holder appears to be in the provision of a two-part cylindrical housing formed from insulating material with the housing sections being axially adjustable for controlling engagement of electrode gripping jaws by the relative axial positions of the housing sections.

2,441,652—Welding Generator—Joseph M. Tyrner, inventor, New York, N. Y., assignor to Air Reduction Co., Inc., New York. (10 Claims)

This welding generator has a pair of bifurcated poles each having a leading shank and a trailing shank with a pair of exciter poles being positioned in quadrature relation to the bifurcated poles. Two pairs of brushes form an exciter belt in the armature in quadrature relation to the pair of bifurcated poles with separate windings on the shanks of one bifurcated pole connected in series with one of such pairs of brushes and the other bifurcated pole having windings connected to the other pair of brushes. Load circuit connections are provided at intermediate points with the windings of the trailing shanks of the bifurcated poles and means for supplying excitation current to the exciter poles are also provided.

2,441,748—Welding Apparatus—James J. Black, inventor, Cincinnati, Ohio, assignor to The Trailmobile Co., Cincinnati, Ohio. (15 Claims)

In this patent, a logitudinally movable carriage is mounted upon a base with substantially horizontal transverse guide rails being mounted on the carriage. A welding unit is mounted upon the guide rails and means for urging the welding unit toward the work surface are provided. The welding unit is guided by means in contact with the work surface.

2,441,886—Welding Machine—Henry Kershaw, inventor, Belleville, N. J. (11 Claims)

The welding machine of this patent includes a work holder electrode and means connected to a support for causing the electrode to move in a fixed path. A second work holder electrode is provided and is associated with the support so that the second electrode may be moved radially and circumferentially with respect to the path of travel of the first electrode.

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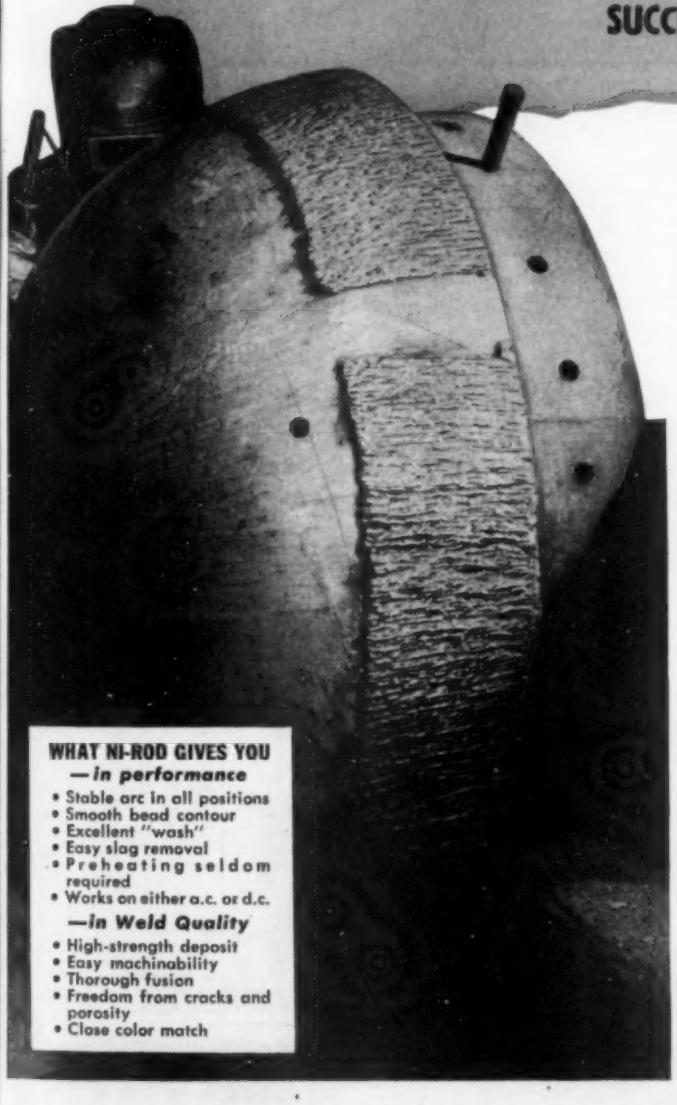

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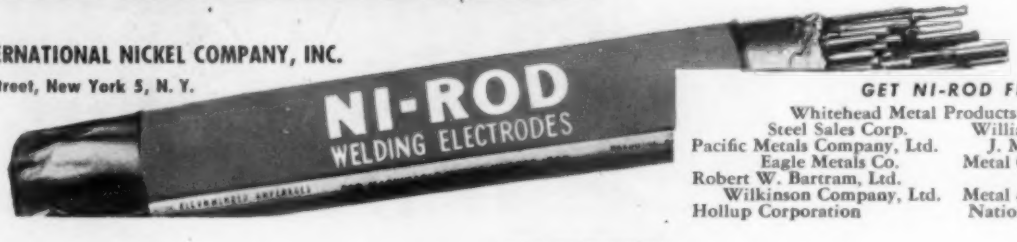

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Wilkinson Company, Ltd. — Metal & Thermit Corporation
Hollup Corporation — National Cylinder Gas Company

List of New Members

May 1 to May 31, 1948

CHICAGO

Barnes, A. J. (C)
Boeninga, Herman (B)
Forrer, J. H. (C)
Howland, Richard L. (D)
Krieger, Robert J. (C)
Mitchell, Robert J., Jr. (C)
Perlock, James (C)
Presson, W. M. (B)
Woodruff, Raymond B. (B)

CINCINNATI

Wright, Neil W. (C)

CLEVELAND

Filimon, Victor D. (B)
Harris Ernest C. (B)
Hawkins, John Joseph (C)
Schreck, Irving Edward (C)
Sheppard, Paul D. (C)
Snow, Charles H., Jr. (C)
Wigginton, Fred W. (C)
Zagar, Frank (C)
Zocchi, Guerin (C)

COLORADO

Cartwright, John S. (C)
Herman, John T. (C)

COLUMBUS

Baysinger, Frank Robert (D)
Hill, Paul Robert (D)

DETROIT

Arnold, Earl B. (B)
Chisholm, Viril H. (B)

HARTFORD

Benoit, Leo T. (C)
Darrow, William L. (C)
Gorman, James F. (B)
Wininger, Thomas E. (B)

LEHIGH VALLEY

Aicher, John Barron (C)
Beedle, Lynn S. (B)

LOS ANGELES

Gill, Sarup Singh (C)
Peterson, Arvid P. (C)
Stoddard, Kenneth J. (C)

MAHONING VALLEY

Helsel, R. H. (C)
Monk, Carl W. (C)

MARYLAND

Beechener, George William (C)

NEW YORK

Lloyd, Thomas E. (B)

NORTHERN NEW YORK

Mahony, Robert P. (B)
Swartz, William M. (C)

NORTHWEST

Arthur, W. G. (C)
Mars, Robert S. (B)
Mazurkiewicz, Pete (C)
Olson, Harry J. (C)

OKLAHOMA CITY

Kraut, Sol (C)

PASCAGOULA

Brewton, R. T. (C)
Cornell, C. L., Jr. (C)
Lennep, Edwin G., Jr. (C)
Surgi, Roy J. (C)
Swigert, A. M. (C)
Tipton, E. J. (C)

PHILADELPHIA

Bissinger, John (B)
Bowers, John W. (C)
Keen, Stanley H. (B)

PITTSBURGH

Williams, Clifton S. (C)

PORTLAND

Thibadeau, B. P. (B)

PUGET SOUND

Martinsen, Thomas M. (C)

SAN FRANCISCO

Nelson, Ben C. (C)

SYRACUSE

Cornell, Paul (C)
Golly, L. Elmo (C)
Marucci, Mathew R., Jr. (B)
Montante, Salvatore J. (C)
Stenerson, R. N. (C)
Teachout, Charles H., Jr. (C)
Wood, Alonzo B. (C)

TOLEDO

Middlekauff, Walter A. (B)

TRI-STATE

Ashby, Martyr (B)
Blackburn, William B. (B)
Brackett, Ausie (B)
Brackett, W. A. (B)
Campbell, Walter R. (B)
Brown, Clifford O. (C)
Camp, Charles C. (C)
Cary, Parker (B)
Cashen, E. E. (B)
Cope, Dana S. (B)
Ficklin, Justin K. (B)
Grabhorn, Henry E. (B)
Hinkle, Ernest G. (B)
Hyland, James C. (B)
Kaufman, Herman C. (B)
Kirkpatrick, R. L. (B)
Koch, Peyton T. (B)
Kraemer, Herman C. (B)
Lex, J. G. (B)
Lowe, L. Dean (B)
Peake, Matthew J. (B)
Reider, Aaron (B)
Roehm, C. J. (B)
Scott, Lester (B)
Seifert, Wilbur S. (B)
Snyder, Howard A. (B)
Soudag, Gilbert Wm. (B)
Ullman, Arthur A. (B)
Von Arb, Edward J. (C)
Wannemueller, Oscar F. (B)
Webb, Howard H. (B)
Werling, Kenneth E. (C)
Williams, Donald C. (B)
Wilson, Richard K. (B)
Woods, Charles E. (B)
Yancey, Harold L. (B)

TULSA

Hannah, Edward L. (C)

WESTERN MASS.

Tuthill, Roger W. (C)

WESTERN N. Y.

Brockelbank, P. T. (B)
Galbreath, Emil M. (B)
Summers, James E. (C)

WICHITA

Lalouette, August (C)
Surovik, Charles A. (C)
Williams, Bert E. (C)

NOT IN SECTIONS

Rice, Vaughan S. (B)
Rice, William A. (B)

Members Reclassified

During Month of May

LOS ANGELES

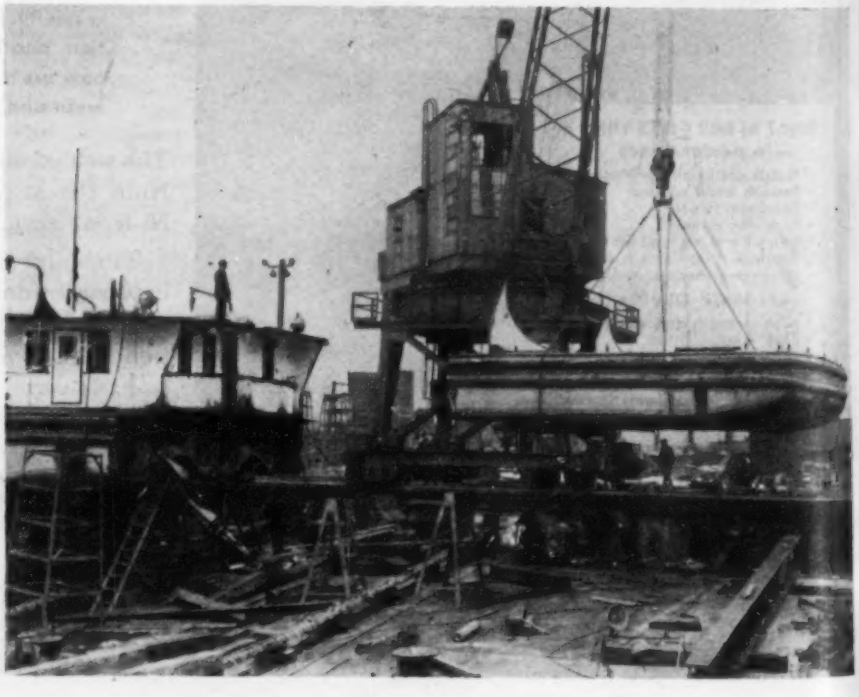
Hanson, Roy E. (C to B)

NEW YORK

Young, Robert T. (C to B)

PHILADELPHIA

Meadowcroft, Benjamin (C to B)

REPAIRING TOWBOAT

Less than 24 hours after Ashland Oil & Refining Co.'s towboat *Ashland* was hauled from the Ohio River to Dravo's Marine Ways, Pittsburgh, a shipyard crane was removing the vessel's stern. A completely new 30-ft. welded steel stern section, previously fabricated in the Dravo Shops, was ready for positioning on the hull as soon as the old section was removed. The program of improvements on the *Ashland* also includes installation of Dravo Kort Nozzles and replacement of existing main engines with two general Motors Diesels removed from a war-surplus LSM (Landing Ship, Medium).